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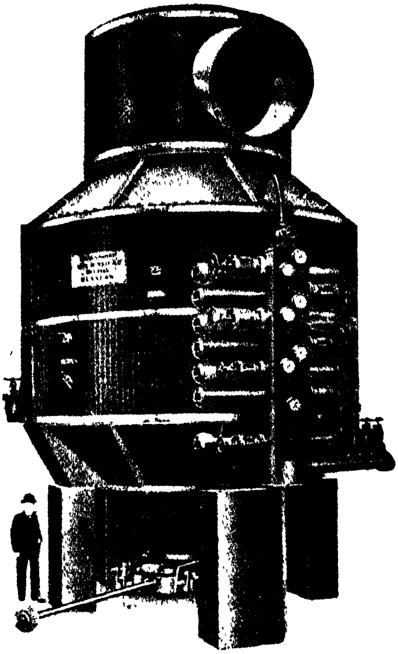

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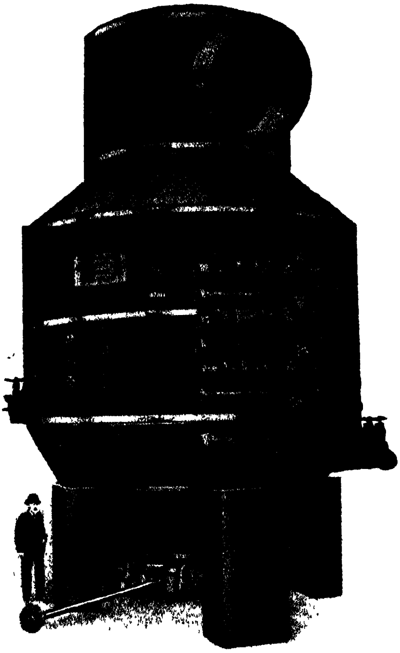

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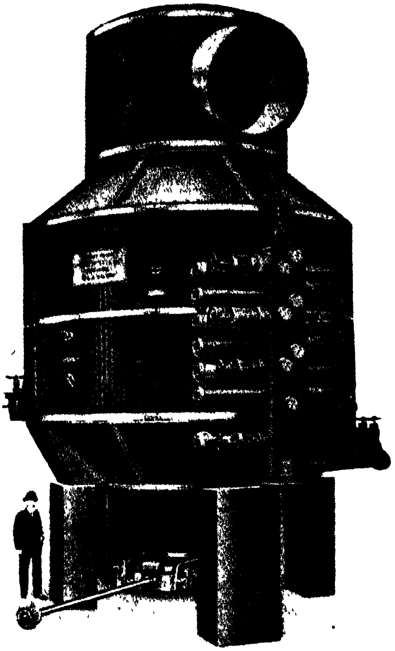

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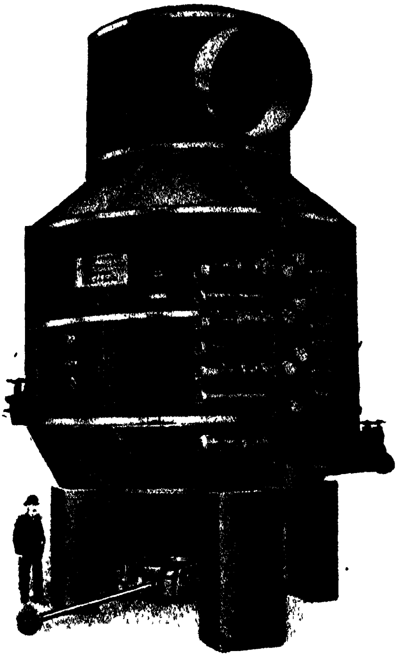

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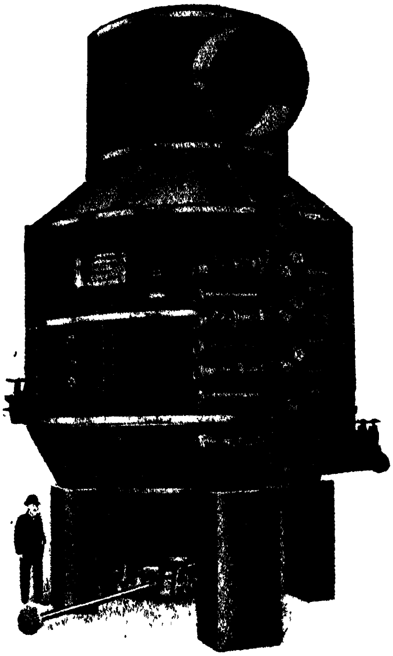

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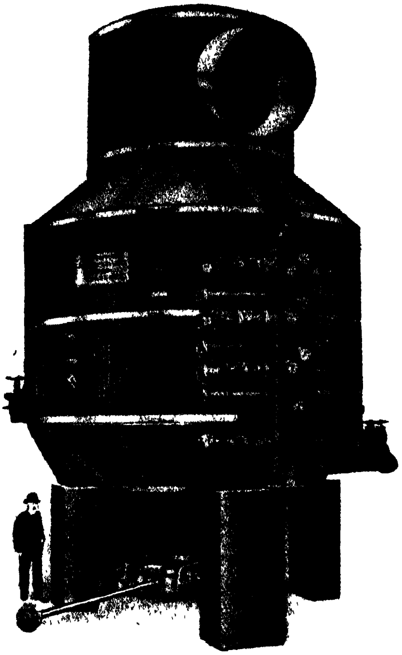

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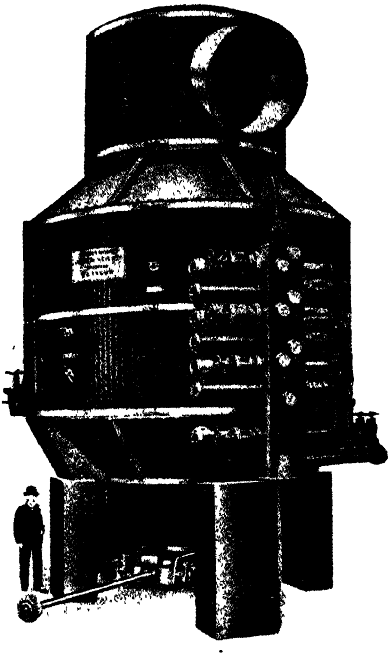

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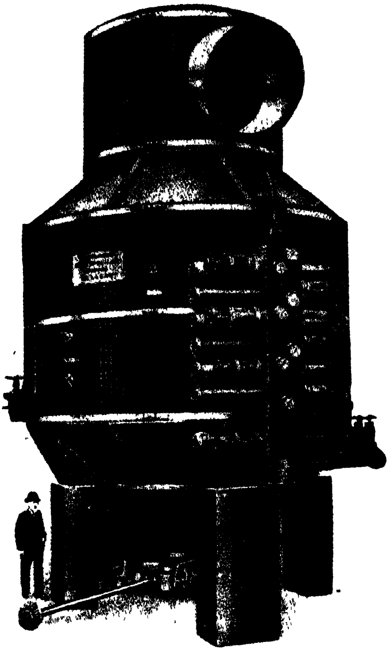

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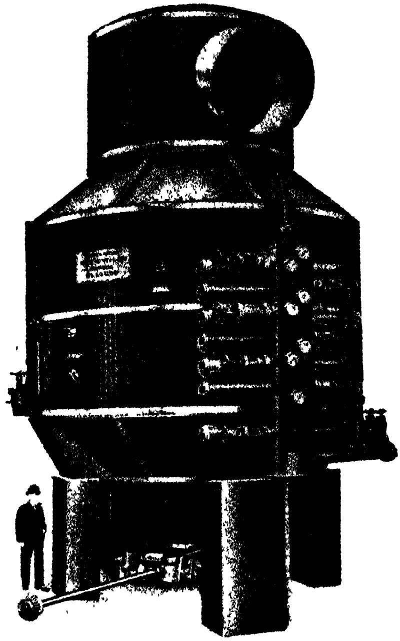

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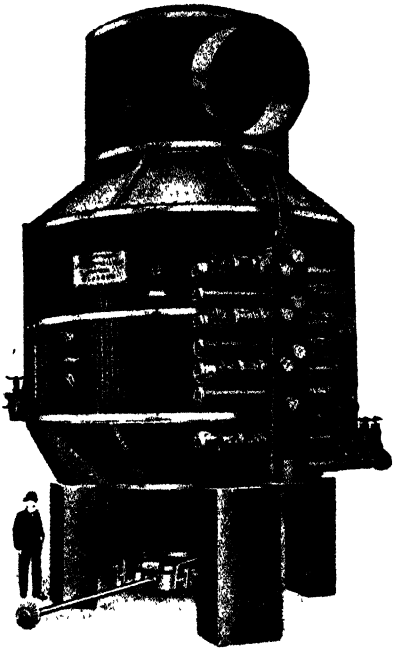

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Managing Editor - - - - - **NORMAN RODGER.**

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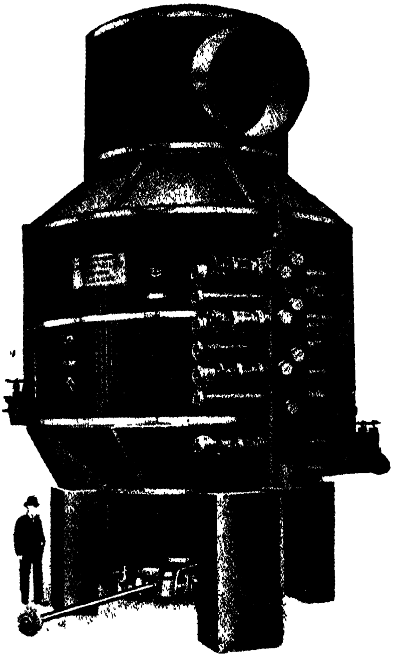

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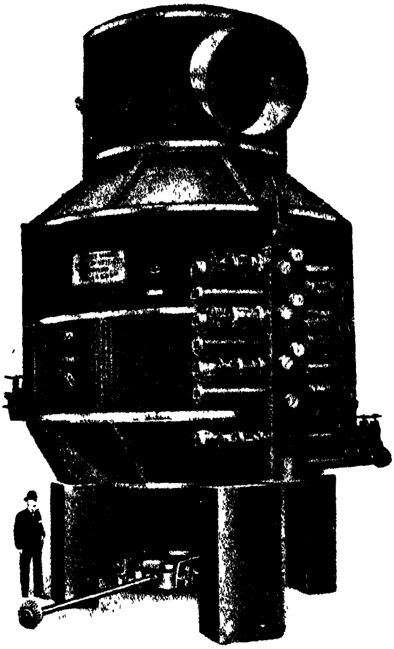

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

Notes and Comments.

The Sugar Shortage.

The new year opens with one fact outstanding from others and this is that sugar consumption has so far outrun production that the consumer is entering on a period of severe competition to secure whatever supplies are available. Competition of this kind in the ordinary course of things always implies an upward trend of prices, and Cuba, the world's chief sugar producer, has lately been raising her price for her raw sugar to a degree that has created a comparative crisis. The British Royal Commission lost valuable time in securing a share of the present Cuban crop,[1] from a number of causes the principal of which was probably the wish to wait and see what the United States Equalization Board was going to do; obviously it was desirable that so far as possible co-operation between the two bodies should continue as previously and there seemed no reason to suppose that the Equalization Board was in danger of premature dissolution. As far back as last August the Board was negotiating with its Government for a new lease of life subsequent to December 1919, but one political delay after another occurred in the efforts to give legislative sanction to this extension of power, and towards the end it was widely assumed that the Board would cease to operate after the close of 1919. But at the very last moment negotiations took an unexpected favourable turn, and Congress was induced to authorize the continuation of the Equalization Board during 1920, though under modified conditions, the details of which are not clear at the moment of writing.

By this time, however, 1½ million tons (or practically 20 per cent.) of the new Cuban crop have already been sold to Europe, and fancy prices have soared up to 12 or even 15 cents. per lb. for early deliveries. Rather than buy at these enhanced prices, the Royal Commision have decided on suspending purchases for the time being in the hope that the sellers will later on moderate their demands; and to allow for this the Ministry of Food have announced an impending reduction in the sugar ration, probably by 25 per cent., to last till supplies again warrant a reversion to the old allowance. At the same time the jam manufacturers' allowance is reduced to 75 per cent. of that of 1919, and the other trade sugar users' allowance is cut down by 50 per cent. Otherwise, the alternative is said to be to raise the retail price of sugar from 8d. to over 1s. per lb.

---

[1] According to one critic they missed their chance in September last, when Cubans for February were obtainable at $6.50 f.o.b.

This step, it will be observed, is taken in the hope that a temporary cessation of buying from Cuba[1] in the early stages of the crop may result in the moderating of prices later on, when there is some congestion of sugar at the Cuban ports and the centrals are in greater need of realizing their stocks of sugar. Much depends, though, on the action of America; if, as is rumoured, the American refiners are about to combine with their British confrères to delay buying Cuban sugar, something may be achieved towards steadying the upward tendency of prices; if too the Equalization Board take steps to co-operate with the Royal Commission to resist excessive prices, a like result may be obtained, and a more reasonable quotation may be secured for the remainder of the crop. At the moment nothing seems to be settled definitely; but it may be assumed that with the continued existence of the Equalization Board now confirmed, the Royal Commission will take early steps to negotiate a satisfactory agreement with them for jointly securing the available sugar supplies. Any other proceeding would be unjustifiable in the circumstances. Much good has been done in the past by the two bodies by means of a system of concerted buying on a large scale. It is to be hoped in the interests of the consumer that a similar plan will be arranged for the present crop.

What has been said above has been written mainly from the consumer's standpoint. The producer on the other hand is naturally taking advantage of the scarcity of sugar to secure if he can a lucrative price. Whether the high prices are justified is mainly a moral question; there can be no plea as to their necessity to cover costs of production and yield, over and above, a merely reasonable profit. But the law of supply and demand being what it is, it is a commonplace nowadays to find producers of scarce commodities making abnormal profits; and sugar producers are proving no exception to the rule.

The plain fact is, the world is faced by an excess of consumption over production that will take years to remedy. In 1913-14 the production of the world amounted to 18,677,400 tons, which more or less sufficed for the consumption. If we allow since then a 3 per cent. increase each year (no excessive figure) we arrive at a total of 22,302,000 tons as the amount in 1919-20, which might be expected to meet the needs of consumption. Actually we are offered by the latest statistics 16,389,394 tons this season, or nearly six million tons less than what might have been expected to be the world's consumption, other things equal. It is true that the consuming capacity of the Continent of Europe has been greatly decreased by the ravages of war, and the much higher price ruling nowadays must tend to check consumption in some quarters. But the United Kingdom would easily take more than her pre-war consumption were it obtainable, for the rise in wages has given to the majority of the population a greater purchasing power than it previously possessed. As for the United States, the increased demand for sugar that followed on the Armistice was greatly accentuated by the Anti-Liquor legislation which came into effect last summer, and the opinion has been lately advanced that the consuming capacity of the United States would not be fully met by less than 4,500,000 tons.

As we said last month, all indications point to the necessity for a greatly increased production of cane sugar; and having regard to the slow rate at which the Continental beet sugar industry will tend to recover, the situation will lie with cane sugar for many years to come. It is, therefore, incumbent on cane sugar producers to extend their output as rapidly as they can. Till they do, there will remain a shortage of sugar in the world, and prices will be bound to remain on the high side. But increased production will not necessarily imply speedy reversion to low prices once more, as too much leeway has to be made up, while as regards competition from beet we give reasons below for believing that the European beet industry can scarcely again secure its old domination by means of cut-throat prices.

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[1] No specific reference is made in the official announcement (reproduced on page 6) but it is fairly obvious that Cuba is the source of the sugar over which purchases are being suspended.

The Technological Outlook on the Continent.

On another page we reproduce a remarkable article from the pen of a well-informed writer as to the conditions ruling in the Continental beet sugar industry at the present day, especially as regards the position of the technological side. Our correspondent, who has had facilities for seeing things for himself, is frankly pessimistic as to the scientific outlook. The chief aftermath of the war is on the Continent, as in the United Kingdom, a social upheaval in which the working classes have been demanding more rational working hours and more adequate remuneration, and as a rule they are getting them. But the men who made the industry in its scientific aspect, the technical chemists and the engineers, who before the war were content to carry on, for a wholly inadequate wage, that research work which, in the case of Germany, went so far to build up her reputation for scientific thoroughness, these men have been thinned out by the ravages of war, and their successors are largely lacking because the necessary training was suspended during hostilities, and may in the future be equally lacking unless the remuneration offered for such high class work is raised to a level that will compare more favourably with the enhanced wages of the skilled or semi-skilled, or even the unskilled, workman. We believe the days are gone for good when a research chemist of 20 years' experience will be content to toil in the laboratory of a German factory for £150 per annum, a very common salary before the war for this class of German worker. The German technologist in the past earned a deserved reputation for hard work, but his employers and his country appear to have reaped undue benefit from his labours. It appears unlikely that such a state of affairs will continue, and Germany will be faced with the prospect, everywhere encountered nowadays, of paying more adequately for the work done. In the beet sugar industry, the difficulty will be increased from the fact that the beet factory does not provide continuous employment from one year's end to another, but is a short seasonal one. For this brief period a more or less trained staff has to be engaged, and it remains to be seen whether this staff will be procurable in the future possessing the same standard of skill that has marked the work of its predecessors. In any event the cost of production will never revert to its old low level, and we may assume that the days of ultra-cheap beet sugar are gone for good. It is clear that labour on the Continent is more unstable and extreme in its demands than is the case either in the United Kingdom or in America; and this fact will not help to secure any early solution of the economic problem in Germany or Austria. The beet sugar industry will therefore probably recover only very slowly from the chaos in which the war has thrown it, and no great scientific progress is to be looked for for many years; it will be as much as the industrialists can do to carry on in rough and ready fashion.

The Kelham Beet Factory Project.

Elsewhere in this issue we give a fuller account than we were able to do last month of the proceedings at the annual meeting of the British Sugar Beet Growers' Society, the body which has in hand the Kelham beet sugar factory project. Unfortunately in giving at the last moment, last month, a brief statement of the intentions with regard to this factory, we inadvertently mentioned that the factory would be in working order by the autumn of this year (1920) whereas actually the date in question is the autumn of 1921. We regret the slip; but we regret still more that it has not been found possible to make a start with this factory during the 1920-21 beet "campaign," since now a whole year is lost. No information was vouchsafed at the meeting as to the reasons for the further delay; we were originally told that the difficulty of getting sufficient beet seed was the main obstacle to an earlier start being made, but it would seem that, now, that obstacle has been overcome. The present difficulty would appear to be more one of getting the factory and its machinery erected in time; and when one knows how much engineering construction work in this country is being delayed by economic troubles and labour strikes, one must assume that the completion of the factory could not be guaranteed in time for tackling this year's beet crop. The project is to be taken over from the Society by a new limited liability company that is about to appeal to the public for financial support but at the time of writing the prospectus has not appeared.

Meanwhile, the Society are carrying on a regular propaganda by means of contributions to the daily press, not only of information relating to Kelham, but of statements relating to the world's sugar supply, all with the aim of pointing a moral that this country should no longer be so dependent on foreign beet or cane for its sugar supplies. This propaganda is laudable as far as it goes; but after all the chief thing is action, and one beet sugar factory will not make a sugar supply, to paraphrase a well-known proverb. The Kelham output will be but a drop in the bucket of the world's sugar supply and even of the United Kingdom consumption. One would be more satisfied if one heard that a dozen Kelhams were projected, in various parts of the country, and not merely one solitary factory which is to serve as an experiment in this new branch of agriculture before others are ventured on. There would appear to be far more time than was anticipated a year or two ago in which to experiment in beet factories in this country before the new industry suffers from the competition of older rivals on the Continent, since it is becoming increasingly evident that the Continental beet sugar industry will recover only slowly from the ravages of the war; but the time available before keen competition may be expected to put in an appearance again is not so ample that we can afford to dally indefinitely. Steps should be taken, with Government encouragement if not assistance, to start the industry in this country in several localities simultaneously, and not await the results of one solitary factory which, while it *ought* to be successful, is too small an essay wherewith to form a judgment of what the country as a whole can do. The output of a dozen 10,000-ton factories would, moreover, be appreciable in respect to consumption, whereas the utmost output that Kelham is capable of achieving would have no relaxing effect whatever on our restricted sugar supply. Till something is done on a reasonably large scale we shall have, as heretofore, to depend for our future sugar on what our colonies can do to extend their existing cane sugar production, plus what we can get from friendly foreign sources like Cuba and Java; and while we are primarily dependent on the latter we shall always be liable to pay more for our sugar than a less dependent country might need to do.

The Royal Commission's Trading Account.

The Royal Commission on the Sugar Supply has recently published its accounts of the period from August 1914 to 31st March 1918, that is for three years and eight months' trading in sugar. We learn that purchases of sugar amounted in value to £152,058,399 and gave a gross profit of £7,356,522. The profit and loss account shows that salaries accounted for £25,828, office accommodation and expenses for £4,063, and interest on advances for £657,637; the net profit carried to the balance sheet was therefore £6,668,993. Of this sum, it is however estimated that approximately £1,000,000 was absorbed in the year 1918-19 by the rise in the price of sugar purchased by the Commission; and further amounts will be similarly absorbed in the current trading year, 1919-20.

We must say it is somewhat unfortunate that the accounts so far published only relate to a period ending nearly two years ago, for the large profit shown has a misleading effect on the ordinary newspaper reader unacquainted with more recent history of sugar transactions, and when every high price nowadays carries with it a suspicion of profiteering, the Government might have avoided the suspicion that they too had done well out of the public. More recent trading accounts should have been available by now.

Mr. Edwin Tate on the Sugar Situation.

At the annual meeting of Henry Tate & Sons, Ltd., held in December at their Mincing Lane offices, Mr. EDWIN TATE expressed approval of the decision by the Royal Commission to continue control of sugar. He said that the future was far from clear. At the end of 1919 there would be a shortage of at least two million tons in the world's supply as compared with 1914. The prospects of increased cane supplies are good, whilst there will be an undoubted increase in the Continental supply. How much this latter can amount to it is difficult to say, owing to the uncertainty of the weather, shortage of coal, &c., but it is evident that the shortage cannot be made up by the end of this year. We must therefore look to the prospects of the possible supplies for 1921 before we can judge of the position, and even if there should be a possible surplus of a million tons for 1921 it would be exceedingly dangerous to withdraw control, for it must be remembered that stocks in all the consuming countries are absolutely bare, and the quantities required to make them up will be very considerable. Owing also to the enormous profits which have been made by the cane producers during the last two or three years sellers will be very independent. On the other hand, buyers will be eager to secure supplies, and with only a narrow margin between supply and demand there may be very heavy fluctuations in prices, whilst, at the same time, there may still be difficulties as regards freights. In his opinion the Government would have to watch events very carefully before they decide to give up control entirely even at the end of 1920, or they may find, as he had pointed out before, that the good which they have done in supplying this country with sugar at a moderate price will be entirely spoilt by a too early abandonment of control.

The Antigua Sugar Factory.

Another annual meeting held last month in London was that of the Antigua Sugar Factory Ltd., at which the chairman, Mr. G. MOODY STUART, made an interesting speech reviewing the history and progress of the Antigua sugar industry during the past 15 years. He sketched the original agreement with the Government to aid them in starting their central factory by a grant of £15,000, and pointed out that the Government had received a good return inasmuch as the Company's payments in the way of excess profits tax have amounted to over £44,000 while the local export tax has yielded £16,951 for the Colonial Government. The substitution of a central factory in place of the old muscovado boiling houses has brought increased prosperity to the islands, as the former poverty and distress have given place to work for all at fair living wages.

The latest action of the company is to create a staff fund by means of which the factory staff will participate in the shareholder's half of the profits in good years. It is proposed that the directors shall have the uncontrolled discretion to set aside 10 per cent of the profit credited to the shareholders, less certain sums which the directors shall decide to be profits to which the work of the staff has not contributed, and less also a sum of £10,000, or £1 per ton of sugar produced, whichever shall be greater. It will thus be seen that the net amount due to the staff is a matter for the directors' decision and no legal right or claim to the Staff Fund is to be allowed, its proportionate distribution being also left to the directors. But it may be assumed that the board under Mr. MOODY STUART, who has the interests of his workers at heart, will see to it that this new fund is a real incentive to good work on the part of the staff; and that can only be the case if the sum to be distributed makes an appreciable addition to the fixed salaries. For the present at any rate the profits to the Company are ample for this purpose, since the dividend declared at the meeting was 50 per cent.

The Sugar Supply of the United Kingdom.

Royal Commission Announcements.

The Royal Commission on the Sugar Supply announced on December 27th that 115s. per cwt. duty paid, ex store, less 1½ per cent. discount, had been fixed as the maximum "reasonable" price for all privately imported, or "free" sugar, for sale to or re-sale by manufacturers from December 29th, 1919, to January 24th, 1920, inclusive. Sugar imported by the Royal Commission would be issued for manufacturing purposes at the following prices: 66s. per cwt. against jam manufacturers' vouchers and 100s. per cwt. against all other manufacturers' vouchers. This latter price would be in force from December 29th, 1919, to January 24th, 1920, inclusive, and would be reduced as soon as circumstances permit.

In consequence of the acute position ruling in producing countries, it has been found necessary for the present, to limit issues to manufacturers to 75 per cent. of the quantity originally intended for the manufacture of jam, and 50 per cent. of the quantity issued during 1919 for all other forms of manufacture.

In conjunction with these restrictions the Food Controller felt bound to warn the public that a temporary reduction of the domestic sugar ration would be necessary at an early date in order to defeat what appears to be concerted action on the part of producers to take advantage of the general position by raising their prices for early deliveries to no less than six or seven times the pre-war level.[1] If the Government were compelled to purchase largely at present it would be necessary to raise the retail price in this country to over 1s. per lb.

In view of the generally prevailing impression that the manufacture of sweets and confectionery is largely responsible for the reduced ration of sugar to the public, the Royal Commission on the Sugar Supply point out that a total prohibition of the manufacture of these articles would increase the amount available for the domestic ration by only 1¼ ozs. per person per week, and at the same time would cause widespread unemployment and much misery to keepers of small sweetstuff shops, who in many instances are widows of soldiers killed in the war.

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[1] In a later statement to the press the Food Controller has explained that the "concerted action on the part of producers" was not meant to apply to British Guiana and West Indian producers who sold the whole of their crops at a reasonable price mutually agreed on; and he much regretted that these parties have been subjected to unfair criticism in the press [on the false assumption that our Colonial sugar producers were among those who were raising their prices excessively].

Notes on the American Sugar Industry.

By our American Correspondent.

Probably never before has the American sugar industry come to the end of a year under conditions of such unsettlement and with an outlook of such uncertainty as characterize the situation at the present time. The transition from strict governmental control of prices, supplies and distribution to a free market, governed solely by the interplay of supply and demand is largely responsible for the existing confusion. It is heightened, however, by the uncertainty that has prevailed as to whether or not official control was to be extended throughout 1920 and by the presence in the market at one time of sugar under control and selling at a controlled price and other sugars not controlled as to distribution and price. Added to all the other elements of uncertainty has been the existence of the strict laws against hoarding and profiteering. These measures, enacted during the war, are still in effect, and under their provisions a sugar producer, selling his product at a price which the market will eagerly offer, may render himself liable to prosecution as a profiteer.

At the present time sugar is selling at widely varying prices. The small remnant of the 1918-19 Cuban crop purchased by the Sugar Equalization Board is being distributed along the Atlantic seaboard and is selling at a wholesale price of nine cents (4½d.). The Louisiana crop which is being turned out mainly in the form of plantation granulated and clarified is selling at eighteen cents (9d.) for granulated and seventeen cents (8½d.) for prime clarified. The disastrous season experienced by Louisiana which has limited the output to less than half a normal crop has led the Attorney-General to rule that these prices will not yield an exorbitant profit to producers and that, therefore, they will be permitted. In some instances, however, sales of Louisiana sugar have taken place at a price as high as 22½ cents (11¼d.) per lb.

For the past two months the beet sugar factories of the Western States have been in operation and fully two-thirds of the whole country has had to depend upon the beet output for its sugar supply. This sugar is not under governmental control except through the provisions of the Food Control Act previously referred to. The Attorney-General announced some time ago that a wholesale price of 10½ cents (5¼d.) would, in his opinion, allow a reasonable profit to the majority of beet sugar companies and that sales above this price level would be subject to investigation. Accordingly, the larger beet sugar companies have been selling on this basis while some of the smaller companies, insisting that if they accept this price they will suffer an actual loss in the season's operations, have been selling at 11 and 11½ cents (5½d. to 5¾d.)

Small quantities of Brazilian, Peruvian, and other whites which have come into this market have been permitted to sell at whatever prices they would bring and actually have been disposed of at 15 to 18 cents (7½d. to 9d.) per lb.

Under such conditions it is small wonder that the producer, as well as the refiner and dealer, scarcely knows where he stands and longs heartily for the time when government participation in his business operations shall cease. While the period of control naturally would come to an end with the final distribution of the old Cuban crop or not later than December 31 the failure of the Senate to accept the Treaty of Peace has left the wartime food laws in control with their sweeping authority to limit profits in the sale of food commodities. Bills looking to the extension of food control to the end of 1920 were introduced at the recent session of Congress but failed of action.

While questions of price have vexed the sugar producer and he has been in the paradoxical situation of being compelled to refuse offers for his output because the prices offered were *too high*, the chief of the consumer's troubles has been, not the price of sugar, but his inability to obtain it at any price. For the past three months this shortage has extended to every part of the country and grocers have doled out supplies to their customers at the rate of one to two pounds a week. What has amounted to a system of rationing has been in effect through limitation of sales to jobbers and wholesalers to one-half the amount they received during the same period of 1917.

A vast deal of discussion has been going on as to the cause of the shortage, and attempts have been made to place the responsibility for it upon the Sugar Equalization Board. This is obviously unfair, however, as the Equalization Board has had nothing to do with the production of sugar, its functions being confined to the equitable distribution of available supplies. As a matter of fact there was considerable apprehension early in the year lest the Equalization Board, in contracting for two-thirds of the Cuban crop, had let itself in for more sugar than could be sold during the year. During the first quarter of the year domestic demand was decidedly slow and refiners were encouraged to accept export business. With the approach of summer a rapid growth in the demand for sugar made itself evident among domestic consumers and this demand, instead of declining in later months as is usually the case, has continued unabated up to the present time. Thus, with supplies only slightly greater than those available in 1918, the American public consumed in the ten months to October 31 more sugar than they consumed during the whole of last year. Under these conditions the prevalence of a shortage during the later part of the year is not altogether beyond understanding. Consumption during these ten months has been at the rate of 92 lbs. per capita for the year which is a higher average rate than ever before has prevailed in the United States. The following figures giving the consumption per capita for the first three quarters of 1918 and 1919 will illustrate the growth in demand:—

	1919	1918
First quarter	20	18
Second quarter	26	24
Third quarter	24	15
	70	57

Some commentators attribute the heavy consumption in the third quarter of the present year to the prohibition of malt liquors and spirits which went into effect on July 1. Undoubtedly, this has been an important factor as the confectionery and soft drink trades have shown a decided increase in business during this period. Full employment of labour at high wages also has operated to increase the consumption of sugar. The situation in brief is that the American people, with a limited supply of sugar available for the year, ate nearly all this sugar in ten months and so have been forced to deny themselves during the remainder of the year.

As to the outlook for 1920, the one certainty is a considerable advance in prices Holders of Cuban centrifugals are demanding 8 to 8½ cents (4d. to 4½d.) f.o.b. Cuba for early positions, which reflects a wholesale price for refined in this market of between 11 and 12 cents (5½d. to 6d.) All domestic crops are running short of early estimates and the question whether or not supplies available during 1920 will be equal to the requirements of this market becomes largely a question of the size of Cuba's crop and the demands made upon it by Europe.

New York, December 2nd, 1919.

The Sugar Trade of the United Kingdom during 1919.

Messrs. William Connal & Co.'s Annual Report.

We take the following excerpts from the annual review of the sugar trade of the United Kingdom for 1919, published by Messrs. William Connal & Co., the well-known Glasgow sugar brokers.

The Royal Commission on Sugar Supply have continued their control of the market during the entire year, so far as domestic consumption was concerned. Early in January they raised the weekly domestic ration per head from 8 oz., which was the rate during 1918, to 12 ozs., at which it has continued till 31st of October. Having in view the gradual relaxing of their control of the market, the Commission, early in the year, authorized the importation by private traders of low grade sugars for manufacturing purposes only, and in March this privilege was extended to any sugars, but under licence, and under certain restrictions as to distribution. These opportunities for outside business were largely availed of. In May the market was thrown open to private traders for business in all descriptions of sugar, but for manufacturing purposes only, and also for export. This led to a large demand, not only from home manufacturers, but also from Continental buyers, whose stocks of sugar had been well-nigh exhausted. It then, however, came to be realized that demand was rapidly outstripping supply, and that buying orders, coming from all quarters, could only be partially filled by available sugar, and then only at advancing prices.

The Royal Commission, realizing the necessity of an increased supply of refined sugars for Europe, consigned 500,000 tons of their Cuban purchase to America, to be refined there "on toll," and thereafter to be exported to Europe. These operations gave ample employment to the American refineries, and enabled them to work for some time to their full capacity of 100,000 tons per week.

The Government limit for granulated for domestic consumption was maintained all the year till 31st October at 57s. 9d. per cwt., duty paid, but for all free sugars large advances were obtained. In May the quotations for white Java, white Mauritius, and American granulated were at the equivalent of 71s. per cwt., duty paid, while at 31st October they commanded 113s. to 118s. on similar terms. British West India Crystals had also advanced from 62s. 6d. in May to 98s., duty paid, in October, and all other descriptions in equal proportion.

Only on one former occasion had higher prices been paid for sugar, namely, during the Napoleonic Wars in 1814, and on reference to the trade reports of this firm for that year, it was found that good Muscovado sugars were then quoted at 134s. to 136s., duty paid (the duty being 30s. against 25s. 8d. now). These were the days when supplies from the West were often interrupted, and markets were in consequence unsettled. After Waterloo, when navigation was again rendered safe, a rapid decline was recorded of 30s. per cwt. from the above abnormal prices.

On the 31st October, when the starved condition of the market was realised, permission to import free sugars was withdrawn, and imports of such sugars after 27th December were prohibited. It was, however, arranged that the importation of sugars contracted for before 31st October would be permitted, under special licence, but all further importations by private traders have for the present been forbidden. By command of the Food Controller the weekly ration was then also reduced to 8 ozs. per head per week, and the limit for granulated for domestic consumption, was raised 1d. per lb., making the price 66s. per cwt., duty paid. Intimation was also made that during 1920 imports would be reduced by 500,000 tons as compared with the present year, authorizing an import for 1920 of only about 1,100,000 tons.

The consumption of the United Kingdom during the past year has been 1,540,648 tons against 1,100,000 tons for 1918. This increase was due to the ration per head having been raised for the greater part of the year to 12 oz., and to the free import of sugar having been allowed for manufacturing purposes from May till October. The consumption for 1920 has been fixed by the Food Controller at 1,100,000 tons, which allows for 600,000 tons being apportioned for the rationing of 8 ozs. per head per week for domestic consumption, and for the remaining 500,000 tons being available for all other purposes.

The British Sugar Beet Growers' Society.

Annual Report for 1919.

The Annual Meeting of the British Sugar Beet Growers' Society was held last month at the Surveyor's Institution, Westminster. Sir **BEVILLE STANIER**, Bt., M.P., Chairman of the Society, presided, and he was supported by Sir **ERNEST JARDINE**, Bt., Vice-Chairman; Mr. **ALFRED WOOD**, Secretary; and other members. Among those present were: The **EARL OF DENBIGH**, **LORD BLEDISLOE**, the **EARL OF CHICHESTER**, **VISCOUNT FEILDING**, Major G. L. **COURTHOPE**, M.P., Sir **EDWARD STERN**, the Hon. **EDWARD STRUTT**, Hon. L. **SOUCHON**, and Mr. **SANDBACH PARKER**.

The Chairman moved the adoption of the Report, of which he gave a brief summary. He pointed out that a profit of £9900 had been made on the Kelham Estate for the past year, most of which had been applied to pay the interest on the mortgage. The estate had now been so cultivated and cleaned that they were ready at any moment to begin to grow sugar beet for the factory, which was to be built before the autumn of 1921. An excellent site in every respect, and especially with regard to transport by railway and water, had been chosen for the factory. Sir **BEVILLE** went on to indicate the valuable preference of £6 4s. per ton which home grown sugar would receive over foreign imported sugar under the Finance Act of 1919. Before the prospectus of the new Company was issued it had been decided to ask the members of the Society to guarantee a substantial proportion of the £250,000, which had to be publicly subscribed in order to meet the Treasury capital of the same amount. Sir **BEVILLE** was able to announce that 15 members of the Committee had already promised £40,000. The Chairman concluded by saying that the more he saw of the Kelham Estate the more impressed he was with its value for the great work which the Society had set itself to accomplish. There was no doubt they would be able to prove to this country that sugar beet could be grown as well in England as in any other part of the world.

The motion was seconded by Sir **ERNEST JARDINE**, Bt., who strongly insisted that English agriculture really needed sugar beet. If he were the Government he would pay down, not simply £250,000, but two and a half million pounds if he could get the beet grown in this country. It was mainly through better cultivation and a better heart in the land that we should be enabled to grow more food. He was rather in favour of the money required being raised by the immediate promoters of the great scheme, but he thought there would be very little difficulty in obtaining from these the preliminary guarantees. Major **COURTHOPE** related some of his past experiences as regards the production of sugar, and said he had not the slightest doubt about the success of the present proposition.

Lord **BLEDISLOE**, who was Chairman of the Royal Commission on Sugar Supply during the war, said he supported this great proposition not only because English agriculture needed sugar beet, but because England needed sugar. He thought that at no time during the last 30 years had there been such a splendid prospect of the success of this industry in our country. Whatever might be the prospect of obtaining sugar from other parts of the world (and that prospect was not improving) it was financially unsound to obtain sugar from abroad if we could grow at home a large proportion of our requirements even at an enhanced price. It would be only through the fault of the management or of the directorate, and through no other causes, if the scheme of sugar production in this country was not a success from both a financial and a national point of view. He gave the scheme his whole-hearted support, and in his judgment there was no earthly reason why the prospective shareholders should not reap a rich reward for the investment of their capital.

It was agreed to authorize the Committee to form the new Company, "Home Grown Sugar, Limited"; to transfer the assets of the Society to the said Company, to approve and publish the prospectus and to execute any documents, and to take all other necessary steps in connexion therewith, including the nomination of the first directors. The question of the financial qualification for the position of a director was raised by Lt.-Col. DONALDSON-HUDSON, and it was moved by Mr. W. T. SPARK, and seconded by Mr. SOUCHON, that the qualification should be a holding of £1,000. Three vacancies in the membership of the Committee were filled by Mr. J. MASON, of Newark, Mr. FRANK DENNIS, and Mr. W. T. SPARK.

At the close of the meeting subscriptions amounting to a further £10,000 were promised.

The British Empire Sugar Research Association.

At a meeting of the Council of the British Empire Sugar Research Association, held on the 16th December, 1919, the following resolution was passed:—

> "THAT a sub-commitee be formed with power to co-opt members to consider and
> "advise on the question of the normal weight of sugar to be used for the quartz-
> "compensating polarimeter in use for technical sugar work."

As is well known, the standard generally adopted is 26·0 grms. of sucrose dissolved in 100 metric c.c., though in France the weight of 16·29 grms. is still in use. DR. C. A. BROWNE (of New York) recently advocated the use of 20 grms. as an international weight for the sugar scale, and chemists in the United States, Hawaii, and Cuba, have in the main expressed themselves in favour of the adoption of this proposal. In France, also, it has been decided to support DR. BROWNE's proposition.

Steps are now being taken by the British Empire Sugar Research Association to obtain the opinion of British chemists upon this important question. At the moment there appears to exist some doubt as to which normal weight should be adopted when ordering new instruments. British scientific makers (who are now in the position to make polariscopes, in the construction of which the Germans had an almost entire monopoly before the war), are much handicapped by the indecision that prevails. This determination to investigate the matter thoroughly will give a helping hand to this captured industry.

Taking into consideration the fact that the British Empire Sugar Research Association has been in existence barely three months, the formation of this sub-committee shows that it is anxious to start work. It is therefore hoped that those who have hitherto refrained from supporting the Association (because they wished first to see what it was going to do) will now no longer hesitate to join it as members.

Fifty Years Ago.

From the "Sugar Cane," January, 1870.

Dr. Wallace, of Glasgow, concluded in this issue his well-known contribution to "The Chemistry of Sugar Refining," dealing finally with filtration through charcoal, revivification of the char, and the evaporation and graining of the liquor. Most of the information regarding the changes occurring in the composition of the char during use, and the nature of the salts and other impurities absorbed from the liquor, is still accepted as reliable, though many improvements have taken place in the method of using and revivifying this material. Explanations of the action of char were not offered, but it was stated that "the active ingredient . . . . . is unquestionably the nitrogenous carbon." This opinion may still be held in regard to animal charcoal, though the belief that "no description of charcoal that does not contain an appreciable amount of nitrogen can be a good decolorizing agent" may be doubted in view of the results obtained with decolorizing carbons.[1] Washing the char was carried out with weak hydrochloric acid, but often Beanes' process[2] of treating with dry hydrochloric acid gas was applied. It was stated that, whereas in the case of dry calcium carbonate no decomposition takes place when it is submitted to the dry gas, in that of dry animal charcoal (especially if it is warm) the carbonate is completely decomposed.

M. Dubrunfaut continued his contribution on "Sugar, Glucose, and Saccharimetry," insisting in this number upon the importance of chemical analysis in the valuation of refined sugars. He said that "already less importance is now attached to the colour which has served as the basis of an absurd official classification. Saccharimetrical and saline analyses have commenced the work of the regeneration of the trade in sugar, and when new light is thrown upon the question, complete justice will be done by restoring the industry to the path which it never should have abandoned. . . . . . The discovery of glucose and its quantity is then of great importance from our point of view, inasmuch as it will enable the refiner to enter on the path of perfection which we have pointed out."

"Sulphite of phosphate of lime" was claimed to offer great advantages as a disinfectant and manure by Dr. B. W. Gerland. It was prepared by treating the tricalcium phosphate with a solution of sulphurous acid, and boiling the solution, the precipitate (which would probably be a mixture of calcium sulphite and dicalcium orthophosphate) being stable at a temperature of at least 130° C. When mixed with soil the phosphoric acid became gradually available, and this preparation was stated to have remarkable effect as a disinfectant and deodorant.

The manufacture of sugar from sorghum was at that time being advocated in America, and samples of white to brown grades had been exhibited. "For a long time the practicability of making sorgho sugar was in great doubt, and even after this was determined it was in greater doubt whether it would pay to do it. These matters are settled, and triumphantly settled."

There were no other articles of technical interest published in this issue. A few patents were noticed. Among these F. Kohn and J. Robert[3] described a modification of a previous process[4] for the extraction of sugar from cane by the diffusion process; while W. R. Lake[5] disclosed a method for drying sugar loaves "by producing currents of heated air in the loaves themselves," so that the time necessary was reduced from 8 or 12 days to only 24 hours.

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[1] *cf.* Zerban, *La. Bull.*, **167**, 27-28.

[2] English Patent, 283 of 1864.

[3] 1498 of 1869.

[4] 594 of 1866.

[5] 1511 of 1869.

The Natal Sugar Industry.

The September number of the *South African Sugar Journal* contains an informative account by E. R. GESSNER of the sugar industry in Natal. The crop is practically confined to the coastal strips and cane cultivation extends so far south as Port Shepstone, which is some way south of the 30th degree of south latitude. There are large areas at present undeveloped, but which are capable of being put under sugar cane with advantage; but, as most of the suitable land near existing mills is already under cane, planting in such new areas will only be possible at an increased cost. The main crop in Natal extends well into the second year after planting and, such being the case, the weight of canes per acre is very great—not infrequently reaching 60 tons we believe. This makes transport a limiting factor. It is Gessner's opinion, therefore, that before the new land can be profitably broken up and put under canes, additional mills will have to be erected, with an appropriate extension in roads, tramlines, and railways.

Planting is usually done in the latter part of the year, from September onwards, that is, during the spring. The rains fall in the summer and the chief cane growth takes place at this time. Milling is done in the drier, winter months, commencing about April and lasting till August or September, but there are considerable variations in this. For instance, because of labour troubles, many mills have of late been working practically throughout the year, with barely time to overhaul the machinery between succeeding crops. The annual rainfall in the sugar cane tract averages from 35 to 40 inches and, as this is considered insufficient to mature the crop, 18 months' growth is considered necessary before milling can be profitably undertaken.

There are two main types of soil, red hill side and black *vlei*. The former is of a free character, is easy to work, but readily dries out and has little plant food: the latter is liable to water-logging, retains moisture well, is hard to work but is fertile. A further type of soil, which is found along the banks of streams, is liable to flooding but capable of producing good crops of canes: presumably this is alluvial. New land yet to be broken up is under grass, grass with occasional trees, or heavy bush. Most estates have land of all these types upon them. As sugar cane land is expected to be continuously cropped for from 10 to 12 years, it is essential for it to be brought into thoroughly good condition at the outset. The grass land, being easier to open up, is generally taken in hand first, and details are given of the most suitable treatment. Heavy ploughs and harrows meet with little difficulty. The cost per acre is given as £4 16s. 0d. Where trees are present a great deal of hand labour is necessary at first, as the ground can only be prepared for implemental work in stages depending on the number of tree stumps. The cost is proportionately greater, reaching, in heavy bush land, £14 10s. 0d. per acre. This is a heavy handicap, but presumably the land is more fertile and large crops of canes are forthcoming.

As to varieties grown, it appears that the *Uba* cane has practically ousted all rivals, although trials have been made of numerous other kinds. As this cane is receiving an ever increasing attention in certain other countries, Gessner's description of it may be of interest. Canes somewhat thin, yellowish or greenish: joints in well grown plants up to 6 in. in length, but much shorter in unfavourable conditions or when nearing maturity: very hardy but containing much fibre: difficult to crush and requiring more powerful machinery than the thick canes: a splendid ratooner, this being one of the chief factors in its extended growth: in favourable conditions capable of ratooning four or five times: leaves adhering firmly to the stem and therefore requiring artificial trashing or burning (which is not considered good practice): deep rooting and adapting itself to the heaviest black and shallow red soils of hill sides: hardy and resistant to insect and fungus attack: arrowing frequent, more so in red than in black soils, but fertile seep never yet obtained in Zululand or Natal: crossing will therefore have to be done in other countries. **Gessner** also mentions *Agaul*, fairly recently introduced from India and greatly resembling *Uba* in general character: this cane appears to surpass *Uba* in rapidity and luxuriance of growth.

The soft canes are spoken of as unsuited to the red soils: they are grown in strictly limited areas of alluvial and *vlei* soils: compare unfavourably with *Uba*: are shallow rooters, poor ratooners, less hardy and pest resistant: are much blown about and twisted and suffer from drought. *Uba* matures in 22 months from plant canes and 20 from ratoons: the soft canes mature in 12 months. They yield about the same quantity of sugar as *Uba*, but demand greater heat, moisture and natural fertility of the soil.

Four good workers will cut and load six tons of cane a day. At the highest about eight tons of *Uba* will produce one ton of sugar. **Gessner** concludes his article with a solemn warning that the sugar industry, in Natal as elsewhere, is about to enter a period of severe competition; and, in view of the prospect of rising wages, it is the duty of the planters to cheapen their methods in every possible respect for their industry to maintain its position. C. A. B.

The Uba Cane in India and Natal.

It has always struck us as an anomaly that a purely tropical crop like sugar cane should have proved so successful in Natal, a country so far outside the tropics, for the cultivation of sugar cane in it extends some distance beyond 30° south latitude. The reason may undoubtedly be sought in peculiar geographical conditions. The sugar tract in Natal is at the extreme southern limit of a great belt of coast land, extending in a northerly direction 2500-3000 miles to Italian Somaliland. This part of the African coast is bathed in warm ocean currents, and the trade winds blow across these on to the land. There is thus a sufficiency of moisture and warmth for sugar cane to be grown all along wherever the soil is suitable. But Natal is very near the southern limit of this tract, and it is not usual for thick, tropical canes to be able in such latitudes to hold their own against those growing in more favourable regions. **Gessner**[1] gives the average annual rainfall in the sugar tract of Natal as 35 to 40 inches, and it is not surprising to learn that sugar cane thrives better in Zululand further north and better still in Portuguese East Africa, where the rainfall borders on 60 inches. There appears to be a considerable extension in cane-growing going on in the latter country just now. We remember noting years ago, on a map showing the distribution of plants throughout the world, that the great palm belt of the tropics after crossing the middle of the African continent from west to east showed a marked downward prolongation on the east coast over just this part of Natal; and this has evidently something to do with the successful growth of sugar cane so far beyond its normal tropical limits.

But another fact has to be considered in the Natal industry. We learn from Gessner's paper that thick tropical canes do not thrive well in Natal, and that the *Uba* variety, a member of the great Pansahi group of indigenous Indian canes, has almost entirely supplanted them. He also mentions that *Agaul*, more recently introduced from India, appears to succeed even better. There are several cane varieties bearing this or similar names in India, but we believe that the one referred to hails from the United Provinces. These two varieties, in Natal, are hardy, very resistant to insect and fungus attack, can thrive both in heavy black soils and free hill side ones, and develop enormous tonnage and rich juice at harvest. This is rather surprising, because they are not extensively grown in India. The Pansahi group of canes reaches its greatest development in the United Provinces and Bihar. They belong to the *Ganna* class of canes which, formerly grown over a large area, have gone out of cultivation because of their liability to disease: their juice, although comparatively abundant, is distinctly poorer in sucrose than many other local kinds, and much more so than when grown in Natal. Another thin cane which has attracted considerable attention during recent years is the *Kavangire*, received in South America from Japan. As the latter country has, we believe, no indigenous cane varieties, it is quite possible that it too came at one time from India. From the descriptions given of it and its general pronounced resemblance to *Uba*, it is likely to come under the same Pansahi group. In any case, these three varieties, *Uba*, *Agaul*, and *Kavangire* are sufficiently alike for it to be somewhat difficult to separate them.

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[1] *South African Sugar Jl.*, 1919, 661.

This marked difference in the behaviour and value of cane varieties of the Pansahi group in India and Natal is sufficiently arresting to lead us to examine the conditions of growth in these two countries somewhat more closely. In Northern India the cane growing period does not usually last for more than six months in the year. Intense heat, coupled with severe drought, militates against rapid growth in the early stages, while extreme cold and diminishing moisture terminate the life of the plants towards harvest. In Natal, on the other hand, GESSNER gives the growing period required by *Uba* to reach its full maturity as 22 months. It is quite possible that, if this cane were reaped in six to eight months from planting, it would be just as unsatisfactory at the mill as in India, both in quantity of cane and richness of juice—perhaps more so. These facts will probably be found to furnish us with an explanation of this anomaly. In Natal, with less extremes of temperature and moisture it appears to be possible for the canes to grow throughout the year, although of course with varying rapidity. Further, the same plants may grow on from year to year for as many as 10 to 12 years continuously, producing paying crops of canes. Presumably the period of 22 months is determined by the comparative richness of the juice and the slowing down of vegetative activity as dry, cold weather sets in. We have no information as to whether flowering puts the finishing touch to the life of the individual cane shoots. At the cane-breeding station at Coimbatore in South India all the canes of the Pansahi group flower abundantly during October and December when eight or nine months old, and some three or four months before harvest. But it has been found possible, by suitable variation of the time of planting, to cause thin cane varieties to flower either in 11 to 12 months or 20 to 21, and it should be possible, with members of the Pansahi group, to vary their length of life between 7 to 8 months and 17 to 18. An interesting series of experiments suggest themselves both for India and Natal.

In the first place experiments might be tried in parts of India to lengthen the periods of growth of some of the native canes. This is not possible in those parts that are visited by frosts or where there is no means of irrigation to tide the plants over the annual period of extreme drought, but there are many places where these disadvantages do not occur. It is quite conceivable that, by considerably lengthening the life of the plant, a richer juice coupled with a greater tonnage may be obtained. As the forcing heat is so great in the Peninsula, it occurs to us that Assam might be a suitable locality for such an experiment. There is greater humidity in the air, the heat is less excessive, and irrigation will not be necessary. The prosperous condition of the industry in Natal calls less urgently for a change in methods, and the line might be to try and obtain a series of cane varieties from India to form a reserve in case the *Uba* cane prove less satisfactory. It is quite in keeping with the history of cane cultivation elsewhere that, at some future period, soon or late, deterioration may set in in the *Uba* cane, as GESSNER has hinted. There are a large number of varieties collected at Coimbatore, besides *Agaul* and *Uba* belonging to the Pansahi class. Canes of the Sunnabile group are also well worthy of a trial. An increasing number of seedling crosses between thick and thin canes are being produced, many of them with varieties of the Pansahi group as one parent and a thick tropical cane as the other, and a few approved canes in this category might be tried. Lastly, there appears to be no reason why similar crosses should not be raised in Natal itself, for it is reported that *Uba* flowers freely in certain tracts, and, if the male or female organs prove sterile, this should render such work much more easy of accomplishment.

C. A. B.

The Question of Policy in the Selection of Cane Varieties.

In a recent paper,[1] F. S. EARLE, Agronomist of the Insular Experiment Station in Porto Rico, estimates that there may be considerably over 500 cane varieties grown in that island; and, before proceeding to describe some of the most important of these, he submits some thoughtful remarks on the policy of planting—which class of cane should be aimed at under each set of local conditions. Thus, the handling of low-grade canes requires abundant labour, for the yields must be large to counter the poorness of the juice: they are more fibrous and harder to grind and the poorer juice requires a greater amount of concentration. The class of cane to be planted therefore depends to a large extent on the amount and character of the labour and the capacity and strength of the mills. In Porto Rico there is abundant labour and the mill capacity is in excess of the supply of canes. A great yield of canes to the acre is therefore to be sought. As has frequently been observed elsewhere, the sucrose percentage in the juice of canes often varies inversely as the vigour of growth, and the chances are that any variety showing excessive luxuriance will be found to have poor juice, and the converse is often true. Thus, in Demerara D 625 is more extensively grown than any other variety and for many years Yellow Caledonia was the favourite, both of them notoriously low in sucrose. On the other hand, where labour is scarce and milling capacity low, it pays better to grow canes with less tonnage but richer juice, and the object is to obtain the greatest possible amount of sugar per ton of cane. The policy to be adopted becomes more complicated where cane-farming is in vogue. The colono wishes to produce a great tonnage of canes, while those in charge of the mills desire a juice as rich as possible, and a conflict of interests is the result. Adjustment is needed; and it is suggested that the best arrangement is that payment should be made for the actual sugar in the canes brought in.

In the formulation of a successful policy of selection of cane varieties a thorough knowledge is required of those planted and their respective yield in different classes of soil, and this knowledge can only be obtained by the keeping of accurate records over a great number of years, "We need to know not only how each variety yields under ordinary plantation treatment on each of the principal soil areas, but how it responds to special treatment—better cultivation, more fertilizer and irrigation. Another most important point to determine is that of comparative resistance and susceptibility to the various diseases and insect pests that attack cane. The failure of kinds commonly cultivated when attacked by some of these many enemies, and the search for kinds having greater resistance, has been the leading cause for the production of this multitude of new varieties." The work of BOVELL in Barbados and HARRISON in Demerara is referred to, especially the laborious and careful testing of the many kinds they have produced and the recording of the results obtained with each under varying local soil and cultural conditions. The author might have spoken of the marvellous work done in this direction for many years in Java, unfortunately obscured by being described in a little known language, but which has been largely responsible for placing the cane industry of that island in its present unique position. But though this work has been of inestimable benefit to the industry in the localities mentioned, it cannot unfortunately be made use of in other places, excepting as a guide to the class of work that is required. In the introduction of cane varieties from other countries, too much importance is attached to the published accounts of phenomenal yields of special canes, and heaven and earth are moved to obtain cuttings of these at the earliest possible moment, without any knowledge of the peculiar conditions of the country where the results were obtained. Before such work is undertaken a careful comparative study should be made of the climate, soil, rainfall and irrigation possibilities, labour and mill capacity, and the success or otherwise of the varieties already established under varying conditions. Then only will it be possible to formulate a successful policy as to the class of cane varieties to be aimed at.

C.A.B.

Agricultural Notes.

The effect of salinity on the growth of the sugar cane.—The tolerance of the sugar cane for salt in the soil is a subject which recurs at regular intervals in the literature of the subject. A couple of references in the West Indian *Agricultural News* (October 18th and November 15th, 1919) have suggested that a few notes on the experience gained at the cane breeding station at Coimbatore may be of interest. For various unavoidable reasons a site had to be selected with slightly "alkaline" soil. Careful preliminary chemical analysis of the soil all over the block showed no inherent objection to growing sugar cane, excepting that sodium carbonate was rather more abundant at one end of the farm than was considered desirable. Good crops of cholam (*Andropogon Sorghum*), ragi (*Eleusine coracana*), cotton, tobacco, millet and vegetables were being grown: and, from experience gained elsewhere, it was confidently expected that with a little treatment sugar cane could also be grown. Lastly, the cultivators around, always the best authorities in a case of this kind, agreed that sugar cane could be grown after a little while, although the land "was unaccustomed to cane." The success obtained and the methods adopted may form the subject of a future note. The first batch of cane varieties planted proved a total failure. These 88 kinds consisted of 47 thick, tropical, and the following numbers of different groups of indigenous Indian

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[1] F. S. EARLE, Varieties of Sugar Cane in Porto Rico. *Journal of the Department of Agriculture and Labor of Porto Rico*, Vol. III, No. 2, April 1919.

canes: Mungo 19, Pansahi 11, Saretha 8, Sunnabile 3. All of them suffered severely, and only 6 Saretha, 1 Sunnabile, and 1 Mungo produced moderate growths. Subsequent experience showed that the carbonate of soda was not present in sufficient quantity anywhere to be harmful, for the thick canes grew best at the end of the farm where it was most abundant. The limiting factor proved to be common salt, as much of this was found to be present in the water used at first for irrigation.

Advantage was taken of the above failure to lay down a permanent "alkaline plot," in which, while the rest of the cane area was being treated, the land was maintained in its original condition and irrigated from the same brackish well. A succession of cane-varieties and seedlings was grown on this plot for five or six years, notes of growth and photographs were taken at stated intervals and the juice was analysed at crop time whenever there was sufficient cane material to do so. Whenever a variety grew successfully it was planted again in the next year, the plot being shifted annually within the area under the same saline conditions; if a variety grew well for two years in succession it was placed in the class of halophytes or salt-resistant plants. The following is a summary of the results obtained for the 5-6 years ending in 1918: the groups include varieties, selfed seedlings and crosses; the number tested is given in brackets and the percentages of successes in the forms planted:—Saretha group (23) 46 per cent., Sunnabile group (10) 39 per cent., Pansahi group (3) 50 per cent., Nargori group (3) 0 per cent., Mungo group (4) 0 per cent., thick canes and ordinary seedlings from them (16) 0 per cent., Rogues among the thick cane seedlings (7) 50 per cent. The juice results will be discussed in a future number of this journal.

The effect of salt on the growth of the canes was very carefully studied from the first and a summary of the observations is added.

1. Germination is seriously affected: in many varieties the young shoots fail to develop, the stand is poor, sometimes only two or three plants are left in the row (although these sometimes grow well), sometimes every one is killed at an early date.

2. Even when a full stand is obtained the colour of the leaves is rarely good, varying from light green to interrupted yellow, to a general yellowish tinge, to clear yellow and, in bad cases, white with blackish patches of dead tissue.

3. Growth is stunted: the canes are shorter and thinner and have short joints: an irregular ill-grown habit is assumed and there is a marked absence of free growing individual canes with large healthy leaves: a bushy habit is often assumed, with excessive branching of the abbreviated joints giving off a mass, of fine grass-like leaves (see this Journal, December, 1919, p. 601, and figure 1). This form of plant can be observed in many fields of thick canes where the irrigation water is slightly brackish. The bush-like plants are most frequent near to the well and are especially abundant where ratoons are being grown. In bad cases the plant leads a struggling existence for some months, the leaves are unequal in length, they fall off and turn black and the whole plant can be pulled up, a decaying mass with hardly any hold in the ground by its short, dead roots. Such has been the normal fate of thick cane varieties grown in the alkaline plot.

C. A. B.

It is stated that practically all the 1920 output of the Kahuku Factory, Oahu, T.H., will be in the form of plantation white, refined by means of the decolorizing carbon process recently described by Peck and Adams.[1] This product will be disposed of locally, and it is expected to command a good price.

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[1] *I.S.J.*, 1919, 72; *U.S. Patent*, 1,251,546; *I.S.J.*, 1918, 431.

Notes on the Sugar Industry of Cuba.

From our Correspondent.

The 1918-19 crop.—Now that the Cuban sugar crop of 1918-19 has drawn to a close, it will be very interesting to study the figures, and set down the salient features of that crop.

From figures which may be considered as very accurate, we have the total amount of sugar made as 3,967,094 tons of 2240 lbs. This is certainly an enormous output; it was made by 196 factories, thus giving an average of 20,240 tons per factory. The following table gives the factory output in groups, and shows clearly the capacity of the Cuban factories:—

1	factory produced			100,000	tons
5	factories produced from	70,000	to	80,000	,,
3	,, ,, ,,	60,000	,,	70,000	,,
5	,, ,, ,,	50,000	,,	60,000	,,
7	,, ,, ,,	40,000	,,	50,000	,,
15	,, ,, ,,	30,000	,,	40,000	,,
35	,, ,, ,,	20,000	,,	30,000	,,
78	,, ,, ,,	10,000	,,	20,000	,,
28	,, ,, ,,	5,000	,,	10,000	,,
11	,, ,, ,,	3,000	,,	5,000	,,
4	,, ,, ,,	1,000	,,	3,000	,,
2	,, ,, ,,	294	,,	612	,,
1	,, ,,			20	,,

This table is very interesting in that it shows that, though Cuba has some very large factories, it also has some very small ones.

Next, it will be useful to look at the quality of the work done in the factories, and in the table overleaf are given the figures for six centrals. These are typical ones and give a good representation of the quality of the work done; but it must be borne in mind that there are factories doing better work, and also many factories doing work not nearly so efficient. On looking over this table, it will be seen that some of the departments show up well as regards quality of work, while in others there is room for much improvement. One thing that can certainly be said about them is this: in the factories cited there is a satisfactory improvement on the work done the previous year; and it may be added that in the large majority of Cuban factories, the quality of work is being steadily improved from year to year.

Taking all the factories in the island, we find that the average recovery of sugar at 96° is perhaps not over 11·10 per cent., but this on a production of 3,967,094 tons of sugar means that there was ground in the factories of Cuba the enormous quantity of 44,000,000 tons of cane.

A glance at the production of sugar in Cuba since the year 1912 will show the advance in production that has been made since eight years ago.

YEAR.	TONS OF 2,240 LBS.	PERCENTAGE INCREASE OR DECREASE OVER PREVIOUS YEAR.	
1912	1,893,687		
1913	2,429,240	28·2 per cent. increase	
1914	2,596,567	6·4 ,, ,,	
1915	2,582,845		0·53 per cent. decrease
1916	3,006,624	16·4 ,, ,,	
1917	3,019,936	0·44 ,, ,,	
1918	3,444,605	14·0 ,, ,,	
1919	3,967,094	15·1 ,, ,,	

Here we see that, with the exception of the year 1915, there has been a continual increase in the production of sugar, and the present indications certainly point to a substantial increase for the crop now started; moreover, from the activity shown in the purchase of cane lands, the evidence points to increased production for some years to come.

CONTROL FIGURES OF SIX TYPICAL CUBAN FACTORIES.

	1	2	3	4	5	6
Cane, tons ground	316,644	240,073	194,207	145,730	501,536	100,407
Tons ground per hour, per set of mills	96·50	86·51	71·34	47·73	73·12	51·59
Extraction, juice per cent. cane	82·52	79·28	78·94	83·14	78·38	81·10
Extraction, sucrose in juice, per cent. sucrose in cane	94·08	92·57	91·41	94·77	91·65	94·36
Dilution, per cent. cane	17·41	6·04	14·64	24·78	15·18	15·51
Sucrose in cane per cent.	14·00	13·01	13·16	14·00	12·05	13·44
Fibre in cane ,,	10·72	10·08	10·48	7·96	11·97	10·57
Normal juice: Brix	18·96	18·08	11·53	17·48	16·83	18·35
,, Sucrose	15·97	15·17	15·23	14·39	13·93	15·65
,, Glucose	1·25	0·97	1·43	—	0·94	—
,, Glucose ratio	7·84	6·39	9·39	—	6·77	—
,, Purity	84·18	83·88	82·21	82·34	82·74	85·26
Polarization	96·90	96·30	96·19	96·00	95·79	95·87
Sucrose account per cent. cane: Loss in bagasse	0·829	0·966	1·005	0·482	1·007	0·758
,, molasses	0·807	0·652	1·051	0·610	1·071	0·977
,, filter-cake	0·098	0·090	0·076	0·060	0·089	0·091
,, unaccounted	0·066	0·001	1·760	0·080	0·036	0·024
Total	1·800	1·709	3·892	1·232	2·203	1·850
Recovery of sugar, 100 polarization	12·204	11·297	10·771	11·222	9·849	11·570
Sucrose in cane	14·004	13·006	13·160	14·000	12·05	13·44
Recovery 96° sugar: per cent. sucrose in juice	96·48	97·74	89·49	93·77	90·287	95·20
,, ,, ,, ,, cane	12·71	11·77	11·22	11·69	10·25	12·07
,, ,, ,, ,, sucrose in cane	90·77	90·48	81·80	88·87	85·128	89·83
Final molasses: Brix	88·72	90·42	86·03	88·23	83·19	89·23
,, ,, sucrose	28·83	26·35	28·18	24·18	29·96	34·56
,, ,, purity	32·49	29·14	32·75	27·41	36·02	38·73
Bagasse, per cent. sucrose	3·91	4·33	4·77	2·86	3·90	3·38
,, ,, moisture	43·90	49·10	49·11	49·04	48·63	48·54
,, ,, fibre	50·64	45·22	44·33	47·26	46·37	47·07
Filter-cake: per cent. sucrose	6·37	8·28	5·87	5·03	5·36	7·77

NOTE.—The above factories are in no way controlled, and therefore the methods employed in the laboratories may vary.

Exportation.—We will now take the figures of exportation and see where Cuba's sugars were consumed during the last few years:—

Destination.	1918-1919.	1917-1918.	1916-1917.
United States	2,793,510	2,065,672	1,965,385
Canada	85,054	9,998	—
United Kingdom	569,814	870,578	787,965
France	153,707	36,498	95,326
Spain	25,113	29,598	28,981
Other European countries	25,596	—	6,593
Mexico	1,063	15,370	1,260
South America	—	550	—
	3,653,857	3,028,264	2,885,510

The above figures do not show the amount of sugar consumed locally, and for the year 1918-19 there is still sugar in the warehouses at the seaports awaiting shipment.

TOTAL EXPORTED TO OTHER COUNTRIES OUTSIDE THE U.S.A.

	1917.	1916.	1915.	1914.	1913.	1912.
Europe	925,724	717,926	373,570	274,349	266,372	116,713
Canada	3,515	—	17,703	8,687	78,457	9,771
Various	1,630	147	—	19,316	28	29
	930,869	718,073	391,273	302,250	344,857	126,513

In the above tables the distribution of Cuba's sugar is clearly laid out, and it will be specially noted that from 1916 onwards a very large amount of sugar was bought by Europe. These points are very indicative, and worthy of close attention by British sugar interests.

Plantation White Sugar.—Encouraged by the high prices offered for plantation white sugar, several factories are being equipped to manufacture that class of sugar. Some are being fitted to turn their whole output into white sugar, others a part only. It does not appear that very great strides will be made this crop, as most of the machinery required has been late in being ordered, and will be delivered late at the factories. However, a good beginning is being made, and no doubt quite a large quantity of a very good white sugar will be marketed, and the experience gained this crop will serve to facilitate wider plans for the manufacture of a good plantation white sugar the following crop, if prices continue encouraging.

Improvements and Extensions.—For the crop now begun quite extensive improvements have been installed in a very large number of the factories. These consist of machinery, such as mills, evaporators, pans, etc., all aiming at a higher recovery of the sucrose in the cane, besides its more economical elaboration; and in many instances improvements will allow of a greater output per factory. A few factories indeed have installed sufficient new machinery to double their output. That is, they have installed under the same roof what might be called another factory, consisting of cane carriers, mills, juice heaters, evaporators, and every equipment necessary to make a complete factory. These centrals have had to do so in order to harvest the large areas of canes planted in their districts a year ago. So it can be seen that notwithstanding the difficulties of getting deliveries of machinery, a continuous improvement and growth is taking place in the industry.

Crude Oil.—Last year a number of the factories put in installations for the storage and burning of crude oil in their boiler furnaces and also in their locomotives. Once they became acquainted with the handling and operation of that fuel, they found it to give such satisfactory results, that it very soon took a strong hold and established itself as a very easily handled and excellent fuel. At the present time many other factories are putting in such installations, and it will only be a short time ere nearly all the centrals in Cuba have a crude oil installation for their boilers and locomotives. The public railroads of the country are also pushing on fast the erection of great deposit tanks for oil, and before very long a large percentage of the locomotives will run with oil fuel.

New Factories.—There are rumours, some well founded and others that will remain as rumours, that quite a number of new factories will be erected in time for the 1920-21 crop. We know that larger areas of cane lands have been bought by capitalists with the intention of growing cane and manufacturing sugar as soon as possible. But there are a few factors to be taken into consideration in all such projects; and of these we have the labour supply, which besides not being over abundant is very costly, and must be handled with the utmost economy; and another, a very important factor, the delivery of machinery, building materials of all kinds, rails for railroads, etc. Were the prompt delivery of such material assured, then, with capable management, there need be no fear as to the development of new lands, and the construction and erection of fresh factories.

Just how many new factories there will be erected in Cuba in the near future it is difficult to say at the moment, but bearing in mind the factors above mentioned, and having some knowledge of the men behind the projects, there seems to us a good chance that four new factories will start their maiden crops in the season of 1920-21.

Messrs. Guma and Mejer's Final Figures.

PROVINCE.	CENTRALS.	SACKS.
Habana	23	2,313,727
Matanzas	26	3,710,617
Cárdenas	18	2,946,733
Cienfuegos	23	2,856,240
Sagua	17	1,437,445
Caibarién	15	1,602,898
Guantánamo	12	1,015,095
Cuba	7	800,230
Manzanillo	9	849,991
Santa Cruz del Sur	1	449,590
Nuevitas	2	474,745
Antilla	22	3,356,034
Nipe Bay	1	307,755
Júcaro	12	2,923,448
Gibara y Puerto Padre	3	1,611,674
Banes	1	468,290
Manatí	1	507,366
Zaza	2	55,985
Trinidad	1	114,572
	196	27,802,435

Equal to 3,971,776 long tons. Seven sacks equal one ton.

Messrs. Guma & Mejer's estimate was for 27,941,000 sacks equal to 3,991,571 long tons, so the actual output has only fallen short of their anticipations by 19,795 tons.

Central Delicias easily headed the list of individual factory outputs, turning out 100,252 tons; Chaparra came second with 78,700 tons.

The Real Situation in the Continental Beet Sugar Industry.

(From a Special Correspondent).

Frequently since the conclusion of the Armistice and the subsequent signing of the peace treaty of Versailles the writer has been asked by British and other overseas friends (who during the war had been deprived of German and Austrian sugar literature) to let them know what during those years had appeared in the province of scientific sugar work in Europe. Some correspondents expressed the opinion that with the end of hostilities the ordinary course of life would be restored fairly rapidly and they wanted to know what new devices in the machinery of sugar-houses and what new processes of manufacture had come into evidence during the last five years and in what publications they could be studied.

It is thus apparent that with these enquirers no exact idea can have been formed as to the immense changes brought about in our Continental life both during the war and subsequently. In every European country, both in belligerent and neutral ones, the whole economic life has been altered and every industry has been diverted from its ordinary course, by the imperious demands of military and naval requirements in the first place, and the food problem of the people in the second one.

In the opening days of the war the soldiers and sailors, both regulars and reservists, were called to the colours, the railways were brought under military command and were chiefly employed for transporting men, horses, guns, ammunition, food, etc., for the troops. Afterwards, as soon as it became patent that the war would last longer than the traditional six weeks that had hitherto been held before us by theorists as the maximum possible duration of a modern war, the factories were commandeered by the government in almost every country for manufacturing and repairing military material. The stocks of cotton, wool, leather, metals, oil, coal, petroleum, benzine, etc., were seized or at any rate rationed and almost exclusively used for war purposes. Later on, the blockade of Central Europe and the submarine warfare curtailed the supplies from overseas, thus giving rise to the wholesale manufacture of all kinds of substitutes, which might be able to serve, as far as possible, instead of the real article, no longer forthcoming. The food supply ran low in almost every country, energy went steadily to waste as time passed and a feeling of despair overran the people at home, who toiled notwithstanding their lack of food, of clothes and of fuel, and worked hard and bitterly just to preserve bare life. The men in the field, facing death and destruction every day, educated by their superiors to bloodshed, to devastation, and in short to breaking every one of the ten commandments, lost gradually the moral strength necessary for civilization and after the revolutions in the great European States the disbanded armies spread the germs of what had accumulated during the war in their own homes, thus upsetting the regular order of things. We witnessed these disasters day by day and from the first day of the war foresaw what must happen, but we never thonght that such a complete collapse of civilization and of the good work done for centuries on behalf of mutual understanding and brotherhood among nations would be our fate.

At this moment the situation on the Continent is almost desperate. Prices are going up by leaps and bounds, monetary values are falling still below the ridiculous rate of exchange at present holding. The labourers are constantly clamouring for higher wages and reduced hours, taxes are going up at a tremendous rate, and yet are insufficient to cover the deficits in the national expenditures.

Coal is lacking, both for industrial purposes and for home fires, railway wagons and locomotives are out of repair and wanting in number. The food supply is short, field labourers are unwilling to do the heavy work necessary for tilling the ground; in short, we see everywhere discontent, unrest, dearth, misery and starvation, and then we ask: Is this the time to come and enquire what improvements have been made in the meantime for the benefit of science and the progress of industry?

We shall not dwell here any longer on the general state of things on the Continent; it is bad enough and threatens to become worse still. But we want to point out a danger which is in store for the Continental sugar industry in particular, and that is the want of men to fill the places of those now in charge of the factories. First of all there is a gap between the old generation and the new one, which it will be very difficult to fill. At the outbreak of war the able men were called away, and the military authorities only very reluctantly set free skilled workers belonging to the sugar factories to do their work at home, preferring to keep them in the ranks. In many cases old employees, already pensioned off, took the vacant places, but were not capable of undertaking the strenuous work of the younger men who had left, all the more as the food served to them was insufficient to keep them fit. The general pace of work went down year by year, discipline decreased daily both from the bad examples to be seen everywhere and also from the general unrest and uneasiness in daily life. The young men in the schools missed the disciplinary rule of their teachers and parents, many of whom had left home for the trenches or for the ammunition factories, thus acquiring less of that useful knowledge that might benefit them in later years. As soon as they left school, often without having passed any final examination, the youths were sent to the army, where they only learnt the art of destruction, or they found work in ammunition factories, where large wages were given to youngsters. As a very young man now received excessively high pay, he did not see the necessity for studying any more, and continued the rather easy routine work in the ammunition factories, which did not develop his mind nor make him fit for life after his work in those establishments ended with the return of peace.

Thus the link between the old employees, who understand their work and perform it regularly and steadily, and the rising generation which comes after them, is broken, and therewith disappears the continuation of a regular supply of reliable and skilled workers.

In many countries the work has been restricted to a maximum of eight hours a day, and as sugar factories work day and night, this new legislation requires the employment of three shifts of workmen, instead of two. Sugar manufacture is a seasonal work, where the workmen are only employed during a couple of months a year. In order to have one complete shift more, with its foremen, overseers, pan boilers, engineers, etc., a quite additional body of men has to be engaged, which must find accommodation in the vicinity of the sugar factory. But nowadays when the materials for building houses are so very expensive that it is nearly impossible to construct new homes, and, on the other hand, the exigencies of the workmen entirely forbid the employment of slum dwellings, it is difficult to see how the regular work required in sugar factories is at present compatible with the eight-hour working day fixed by law.

Finally, there is another danger and that is that the technical and chemical employees are so poorly paid and, in every respect badly treated that it is to be feared that after a short time the younger technical generation will refuse to become employed in the sugar industry, and then it will not be possible to secure the supervisors and other capable foremen, whose energy, knowledge, experience, and zeal have hitherto made the European beet industry so prominent in the world's sugar industry.

We will quote here a few instances from four European countries, among which Russia is not even mentioned. In a speech made at a meeting in Berlin on May 22, 1919, of the Association of the German Sugar Industry, Dr. Claassen said, after having reported on the progress of the industry:—"The review of the technical and scientific work in the sugar industry is by no means a rosy one. If we consider a sugar-house not only as an establishment where a large quantity of beets has to be rushed through, but one where the maximum of good and sound sugar has to be extracted from the roots, thereby leaving as a by-product a well-exhausted molasses, we cannot speak of any progress in the last few years. What a silent observer might witness in this respect would fill us with utter astonishment. The chemist has so little say in the work to be done, and his skill and experience are so greatly disregarded, that many factories have found it more convenient to work without a chemist at all, or, at the most, to employ a few assistants, principally girls. Active as such assistants may be, they could not replace the real trained chemist."

The following day Dr. Herzfeld addressed the assembly on this same point and urged the sugar manufacturers to employ the young men then studying at the Sugar Institute of Berlin. He wound up by saying:—"If we do not make use of this present moment to secure the young men now available, whence shall we afterwards obtain our technical assistants? It is true that the girls possess all the rights, they wear also the proper garb with which to run about in the factory without being caught by machinery, but that does not mean that we can use them as technical assistants. I must therefore ask directors who are looking out for young people to employ the young men. They will be more useful than girls, for without saying anything against the merits of the other sex, my pupils have learned more and better than girls could do, even when these have undertaken a special course following on their college training."

At a meeting of the Association of French Sugar Chemists at Paris on July 26th, M. Dubaele drew attention to the fact that during the war and afterwards urgent appeals were directed to the patriotism of sugar chemists, but that they had not received a corresponding remuneration. Every worker clamours for better pay and the more a man clamours, the more he obtains. The silent chemist, however, is forgotten and is left to subsist on a simple pay of 200 francs a month during the campaign and nothing at all during the off-season.

In the Belgian *L'avenir agricole* we find a paper by Milleca Lamarck bitterly complaining of the position of the sugar chemist in that country. The article is much too long to find a place here in these pages, but it is full of complaints of elementary work expected in addition to scientific obligations, of bad treatment, and of the very low salary of 600 to 700 francs per season. We quote a few remarks from the paper: "The chemist will encounter every trouble to find a suitable lodging at the location of the factory, notwithstanding the high prices asked, and he may consider himself a lucky man if he is not compelled to live in a dirty den where he has to rub shoulders with a lot of riff-raff with whom he has to exchange drinks in order to remain friends. For his delightful salary he has to work very strenuously from 6 or 7 o'clock in the morning till 9 or 10 o'clock in the evening, with only short intervals for meals! The laboratory consists of a badly lighted and badly ventilated room in a corner of the factory, where everybody who wants to have a look at the sugar-house is free to enter and converse with the man in charge."

In Holland matters are rather bad too. The qualified sugar-house chemist is paid 100 guilders per *month* (if not only 75) for which sum he works 12 hours a day and has to find his food and lodging. The factory hands, most of them unskilled labourers, receive as much as 70 guilders per *week* and even the laboratory boy, who fetches the samples and washes the bottles is entitled to a *weekly* wage of 30 guilders, or more than the qualified chemist, his superior in the factory. The result is, if that superior wants him to do work in the dinner hour which is the privilege of the workmen and not of the chemist, he is snubbed and invited to do tho things himself if he wants them done.

If matters are going to continue like this in Europe, no sensible young men will choose the sugar industry as a means of livelihood or of subsistence, and it is to be feared that, as soon as the present generation has given up work, enquirers overseas will look in vain for improvements or new suggestions emanating from the Continental beet sugar industry.

Kavangire: Porto Rico's Mosaic Disease-Resisting Cane.

Something of its History and Behaviour in the Argentine.

By ARTHUR H. ROSENFELD, M.S.,

Ex-Director of the Tucumán Sugar Experiment Station, Argentina.

That "one half of the world does not know what the other half is doing" is an aphorism which had its birth many hundred years before the epoch of scientific agricultural investigation and publications, and which cannot be applied to the scientific world to-day. In the sugar cane world, particularly, we have of late years had many examples of a discovery or conclusion arrived at in one country being of equal or much more far-reaching value in others, the success of the Demerara 74 seedling cane in Louisiana and of the Java 36 and 213 seedling canes in Argentina being cases in point. Naturally the obtaining of these canes in Demerara or in Java did not signify *per se* that they would be superior to the canes in use at that time in Argentina, but the facility of international scientific exchange and the availability of publications referring to experimental work in all parts of the world made the securing of these varieties for trial in competition with hundreds of others in their new homes an easy and interesting affair.

Prof. C. O. TOWNSEND, of the United States Department of Agriculture, has recently called attention in "Science"[1] to an interesting example of how experimental work in one country may result in far-reaching importance to the principal industry of another many thousands of miles removed. Several years ago an extremely serious sugar cane disease made its appearance in Porto Rico and, on account of its characteristic spotting of the leaves, came to be known as the *mottling or mosaic disease*. In many respects it appears to be identical with the well known yellow-stripe disease so common in Java, and Dr. C. W. EDGERTON has recently published an interesting article in the *Louisiana Planter* showing that it exists quite commonly in Louisiana, although its ravages would appear to be less pronounced there than in Porto Rico. When the seriousness of the new disease in the island was fully appreciated, the Porto Rican authorities requested the cooperation of the United States Department of Agriculture with their own insular and federal experiment stations, and Prof. F. S. EARLE, of the Office of Sugar

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[1] "An Immune Variety of Sugar Cane." *May 16, 1919.*

Plant Investigation of the Bureau of Plant Industries, was detailed in 1918 to take up this co-operative work.

"Among other lines of investigation Professor Earle studied very closely the sugar cane varieties growing in Porto Rico. He noted that among about twenty varieties growing at the Federal Station at Mayaguez there was one Japanese variety (Kavangire) which showed no sign of the mottling disease, while all the other varieties were more or less seriously affected. In order to carry this study further Prof. Earle inaugurated an experiment with ninety varieties of cane on Santa Rite Estate. . . . Single rows of cane were planted of the varieties to be tested, and every third row was planted with the diseased seed of the Rayada variety (ribbon cane). In this way each variety was uniformly and completely exposed to the infection.

"The first planting of the ninety varieties was made on Oct. 1, 1918. Two and one half months later all of the varieties except Kavangire showed the mottling disease, the infection running from 9 per cent. to 96 per cent. This variety has remained free from disease to date, March, 1919, and shows every indication thus far of being immune to the mottling disease.

"On Jan. 29 of this year, Prof. Earle made a careful study of the experiment and found about half of the other varieties in the experiment showing infection of fully 100 per cent., and only in two cases was it as low as 50 per cent.. The degree of infection, however, was decidedly marked in the different varieties, with the exception of the Kavangire which appears to be entirely immune. Prof. Earle has observed that Kavangire fully matured on the Federal Station at Mayaguez, and in other localities in Porto Rico where it is growing, it is entirely free from the mottling disease whether the plants are young shoots or mature canes."

A Brief History of this Cane in Argentina.

This cane figured amongst the first varieties to be tried out at the Tucumán Sugar Experiment Station, it being planted with two hundred other varieties in 1910, and showing from the first germination remarkable vigour, dark colour, high agricultural production, fair juice if left for late cropping, and extreme resistance to fungus disease such as Rind Disease and Red Rot and attacks of boring insects such as *Diatræa saccharalis*. It was obtained from a lot of varieties under trial at the National Agricultural School in Tucumán, which had in turn obtained these varieties from the Experiment Station in Campinas, Brazil.

It was at once recognized that in this case we were treating with a misnomer, as the labels had evidently been mixed either in Brazil or in the Agricultural School at Tucumán, and *Kavangire* was merely a layman's attempt to spell Cavengerie, to which cane the one under discussion bears absolutely no relation, being a typical Japanese bamboo type of cane, identical with the Uba variety of Natal, whereas the Cavengerie is a large, soft, red cane with faint black stripes. In 1886 Dr. Alvarez Reynoso, of Havana, Cuba, sent to Dr. W. C. Stubbs, Director of the Sugar Experiment Station in Audubon Park, Louisiana, 27 canes of Cavengerie weighing 186 lbs., or about seven lbs. per stalk.[1] These weights in themselves prove that there is no similarity between the Cavengerie cane and the thin, Japanese bamboo type of cane, which in our experiments in Tucumán gave an average weight of stalk for many years of just 490 grms., or just a little over one lb. avoirdupois.[2]

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[1] "Sugar Cane." Issued by the Louisiana State Bureau of Agriculture and Irrigation, p. 61. An early and interesting discussion of varieties.

[2] Rosenfeld, Arthur H., "Revista Industrial y Agricola de Tucumán." Vol. III., page 122, August, 1912.

Not being able to classify the cane exactly, although it appeared identical with the Uba and similar to the Zwinga, being apparently of better average sugar content than the latter, we continued our experiments with the variety under the name of Kavangire, and it was under this name that we sent a consignment of this cane to Prof. D. W. May, Director of the Federal Experiment Station at Mayaguez, Porto Rico, some time after publishing a description of it and other promising canes under trial in Tucumân in the *International Sugar Journal* of January, 1914.[1]

It is interesting to note that this article is the only one published in English in regard to this cane up to the time of the recent articles of Earle, Townsend, and Edgerton.[2] In it the author gives the results of two years of experimentation with the Kavangire in comparison with the native striped and purple canes (Cheribon), comprising one crop each of plant and stubble. In view of the importance which this cane has now assumed, a review of its behaviour in the crops of 1911 and 1912 will not be out of place. Table I gives the results obtained in these crops in succinct form.

TABLE I.

YIELDS AND ANALYSES OF KAVANGIRE AND NATIVE CANES.

I.—Average of Native Striped and Purple.

Age.	Met. tons Cane per hectare.	Av. Weight Stalks, grms.	CHEMICAL ANALYSIS					Kgs. Sugar per hect[4]
			Brix.	Sucrose.	Glucose.	Purity.	Mfg. Value.[3]	
Plant, 1911	27·206[5]	570[6]	16·3	13·6	0·4	83·7	11·44	2201
Stubble, 1912	30·080	750	16·2	13·7	0·5	84·3	11·52	2417
Average	28·643	660	16·3	13·7	0·4	84·0	11·48	2309

II.—Kavangire.

Age.	Met. tons Cane per hectare.	Av. Weight Stalks, grms.	Brix.	Sucrose.	Glucose.	Purity.	Mfg. Value.[3]	Kgs. Sugar per hect[4]
Plant	43·490	340	15·9	11·6	0·8	73·0	8·47	2579
Stubble	108·630	630	14·8	12·5	0·5	84·5	10·56	8030
Average	76·060	490	15·4	12·1	0·6	78·6	9·52	5305

A glance at this table shows that as plant, while giving 16 tons of cane more per hectare than the native canes, the chemical analysis of the Kavangire juice was far inferior to that of the native canes, the commercial or manufacturing value being about three points lower. Hence the yield of sugar per hectare was only about a third of a ton more than that of the native canes, this being obtained, naturally, at greater expense in the factory, due to its low industrial yield, but at very much reduced cost in the field, due to much cheaper cultivation: the Kavangire being an extremely rapid grower and shading the middles quickly. As stubble, however, the Kavangire almost tripled its agricultural yield, and, with almost as good juices as the splendid ones of the native canes, more than tripled its yield of sugar per hectare of the previous crop, giving us more than five and a half tons of sugar above the yield of the native canes under identical conditions! The average yield for the two years was almost three times as much cane, and well over twice the amount of sugar per hectare.

For the three following years, *i.e.*, the crops of 1913, 1914 and 1915, the yields of cane per hectare of stubble of these plantations were as shown in Table II.

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[1] *Idem*, "The Most Promising Varieties of Sugar Cane under Trial at the Tucumán Experiment Station." Vol. XVI., No. 1, pp. 12-23. [2] *Loc. cit.*

[3] Obtained by multiplying per cent. Sucrose by Purity. A practicable factor for average juices in Tucumán, likely to indicate too low a probable yield for juices below 70 purity and rather too high a one for juices above 80 purity.

[4] Calculated on a basis of 70 per cent. extraction of juice on weight cane.

[5] 242,320 lbs. to the acre. [6] 1¼ lbs.

If we bear in mind that the Kavangire cost only about 50 per cent. as much per acre in cultivation as did the slowly-growing native canes, the cost of production per ton becomes about 15 per cent. of that of the native cane.

TABLE II.

Yields of Cane per hectare as Second, Third, and Fourth Year Stubble.

Crop.	Metric tons (2207 lbs.) Native.	Kavangire.	Advantage in favour of Kavangire. Per cent
1913..	26·55	112·21	over 400
1914	17·40	70·70	,, 400
1915..	14·80	88·00	,, 600
Average....	195·58*	90·30	over 450

The behaviour of this cane, then, in comparison with that of the native striped (the native purple, being next to this Japanese type of cane in the experiments, had been so shaded by the latter that the yield cropped to almost nothing in 1914 and 1915, hence we had to make our comparisons with its more favoured companion) during five years from one planting can be graphically appreciated by studying Table III.

TABLE III.

Average Yields for Five Years.

Variety.	Met tons Cane per hectare.	Av. weight Stalks, grms	Chemical Analysis. Brix.	Sucrose.	Glucose	Purity.	Mfg. Value.[1]	Kgs. Sugar per hectare.
Native striped	23·149	650	17·0	14·8	0·3	87·1	12·9	2090
Kavangire	84·606	520	16·8	13·3	0·6	79·2	10·5	6219

One crop of plant and four of stubble, then, gives us an average yield of cane and sugar per hectare for the Kavangire of three times that of the native striped cane, it being interesting to note that the average yield of the native striped cane in Tucumán in the five years under study (1911 to 1915 inclusive) was considerably less than that which we obtained in these experiments at the Sugar Experiment Station.

These, however, are the results of but one planting from these canes; let us see how distinct plantations have conducted themselves, thus avoiding the always dangerous tendency to form opinions from one single experiment. Although substation experiments all over the Province had confirmed the above results through the crop of 1913, we resolved that year to start a new series of experiments in the Central Station, selecting for this object a piece of land which had been growing alfalfa for the previous two years, and which, therefore, was in splendid shape for cane. The plot was well prepared early in July, the cane being planted in deep furrows 5½ feet apart, and covered with a small share plough. Germination was quick and good, there being no frost in 1913, and the germinative propensities could, hence, be carefully studied. This is an important and indicative factor in the success of the Kavangire cane, and its significance may well be appreciated from a glance at Table IV. Beginning about the middle of December, counts were made at frequent intervals of the number of sprouts above the ground, these counts being carried on until the Kavangire began to sucker.

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* Strange as this may seem, this represents the average yield of the native canes in Tucumán for the ten years previous to the establishment of the Tucumán Sugar Experiment Station—about nine tons per acre!

TABLE IV.

Germination Tests.

Number of Sprouts above Ground, per row of 100 metres.

Variety.	Sept. 18.	Sept. 25.	Oct. 2.	Oct. 9.	Oct. 16.	Oct. 23.	Oct. 30.	Nov. 6.	Crop.
Average native striped and purple	34	85	121	143	169	207	244	278	682
Kavangire	62	208	360	476	537	602	680	791	2366

Nothing could show better than these counts, the inherent vigour of the Kavangire. From the first moment of germination the Kavangire was producing twice as many stalks as the native cane, and by October this proportion has increased to three times as many. At crop time we found that this latter had more than held good.

Now let us see the results given in the crops of 1914 and 1915, which were plant and stubble respectively.

TABLE V.

RESULTS FROM THE SECOND PLANTING.

I.—Average of Native Striped and Purple.

Age.	Met tons Cane per hectare.	Av. weight Stalks, grms	CHEMICAL ANALYSIS. Brix.	Sucrose.	Glucose.	Purity.	Mfg. Value.	Kgs. Sugar per hectare.
Plant, 1914	25·26	615	17·3	14·1	0·2	83·2	12·0	2122
Stubble, 1915	30·78	575	14·0	10·7	0·8	76·4	8·2	1767
Average	28·02	595	15·7	12·6	0·5	80·3	10·1	1981

II.—Kavangire.

Age.	Met tons Cane per hectare.	Av. weight Stalks, grms	Brix.	Sucrose.	Glucose.	Purity.	Mfg. Value.	Kgs. Sugar per hectare.
Plant	83·40	590	15·9	12·2	0·5	76·7	9·4	5488
Stubble	102·18	550	13·9	9·6	1·5	69·1	6·6	4721
Average	92·79	570	14·9	10·9	1·0	73·2	8·0	5196

Attention should be called to the fact that frost fell very early in the crop of 1915—before hardly any factories had started grinding—and that this fact explains the low purities of that year. Nevertheless, the average results from plant and stubble compare very favourably with those obtained three years previously, as shown in Table I. The notable point about this table is the splendid agricultural yield and fairly good juice of the Kavangire as plant in 1914, although the juice cannot compare with that of the native canes. In both years the agricultural yield of the Kavangire was three and a half times that of the native canes, and the sugar yield two and a half times as much. As the yield of *sugar per hectare* is the crucial test of any cane, these repeated figures may be taken to represent pretty accurately the comparative value of the canes. Let us see, then, what the average of seven crops of these canes (two each of plant and first year stubble and one each of second, third and fourth year stubble) looks like. These averages bear out the individual years' results for plant and first year stubble, Kavangire yielding over three times more cane and sugar per hectare than the native canes.

TABLE VI.

Average Results from Seven Crops.

Variety	Met. Tons Cane P. H.	Av. Wgt. Stalks Grams.	CHEMICAL ANALYSIS. Brix.	Suc.	Gluc.	Purity	Mfg. Val.	Kgs. Sug. Per Hect.
Native Striped	23·272	640	16·6	14·1	0·4	84 9	12·0	1955
Kavangire	86·944	530	16·3	12·6	0·7	77·3	9·7	5903

Problems Presented by this Cane.

Prof. TOWNSEND goes on to say[1] :—"The Kavangire cane is tall-growing and very slender, while the Porto Rican planter prefers a thick cane, because *it appears*[2] to be a better yielder and is handled at less expense; Director MAY reports a yield at the rate of 70 tons per acre on the Mayagüez plat. The Kavangire cane was imported into Porto Rico from the Argentine a few years ago by Mr. May. In Argentina it has been planted quite largely on a commercial scale, indicating that it is satisfactory from the standpoint of sugar production. It requires a long season for maturity and for this reason has not been recommended for general planting in the Argentine. The sugar per acre is the crucial test, and in this respect it generally stands near the top.

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[1] *Loc. cit.* [2] The italics are the author's.

"After reviewing the available literature in regard to Kavangire, Prof. Earle raises the practical question as to whether or no Kavangire can be successfully used for general planting in Porto Rico. If it can and it retains its immune characteristic, the question of combatting the mottling disease is solved. This question of the practicability of using Kavangire is now under consideration by Prof. Earle and his co-workers in Porto Rico, and at the same time further observations will be made upon the immunity of this variety to the mottling disease. In the meantime its adaptability to the Porto Rican climate and labour conditions will be determined. It appears to be a strong ratooner and to have considerable resistance to root disease, borer, and stem rot. If these indications prove true Kavangire should enable the grower to keep his fields in profitable production longer without replanting than is possible with the varieties now in use. This will reduce the cost of production, even though the habit of growth and quality of the cane should make it a somewhat more expensive variety to handle and to mill."

These are the same difficulties which presented themselves when we began our campaign five years ago to replace the rapidly degenerating, though thick and pretty, native canes with the thin, rapid-growing, but not at all aesthetically appearing Java 36 and 213 which have since been universally adopted in Tucumán, only a few rows of native cane being occasionally seen to-day, carefully guarded and nursed as an invalid might be by the friends of his youth. In this connexion I can do no better than quote the first part of the article already cited in the *International Sugar Journal* for January, 1914, which, in view of the events of the past five years, has turned out to be almost prophetic:—

"The first thought that would probably strike one upon seeing specimens of our most promising canes is that those which appear to be giving the best results to date are canes of small diameter. This we must grant at the outset and must also state here that, from the two years' results we have now obtained, *the thin canes as a class seem more promising than most of the larger ones.* We are inclined to admire a thick, heavy cane and it is but natural. Yet, with some very few exceptions,[1] these large canes have not sprouted so readily nor given us so thick a stand as the thinner ones.[2] In view of the fact that so many of our promising canes are of small diameter, its seems advisable to call attention to a few of their good points which are frequently overlooked:—

"*Firstly.*—As will be seen further on, from the figures given, the fact that a cane is thin does not signify that the average weight of stalk is less than that of the thicker ones. With us, and generally in the Province,[3] thinner canes have attained considerably more height than the thicker ones and, with one or two exceptions, the average weight of stalk of these, calculated from several thousand canes, compares favourably with that of the thicker canes, and very often surpasses the average weight of the canes of the place grown under identical conditions.

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[1] These exceptions have since disappeared.

[2] There is no doubt that, from the aesthetic point of view, we are all inclined to admire a thick, heavy cane, exactly in the same way that it is pleasing to look upon a well-built, fine-looking man. Nevertheless, none of us would employ this splendid-looking physical type in our businesses in preference to a smaller and less attractive man if the latter could do his work better and give us better financial returns as the result of his labours! If it be almost axiomatic that the biggest men do not always make the best soldiers, it is equally true that the most beautiful plants are seldom the most useful to the economy of men. In business—*and agriculture is the most important of all businesses*—utility weighs more in the balance than beauty—the practical result must in the long run count far more than the aesthetic effect. And, after all is said and done, is not that plant most beautiful which helps most towards educating our children, improving our homes, and making our farms healthier and more attractive?

[3] We can now say, "Generally in the Argentine sugar sections of Tucumán, Salta and Jujuy."

"*Secondly.*—While we must grant that it would probably cost a little more per ton to strip very thin cane for milling, if we consider the heavy stands of most of them and the short distance a man has to walk to cut a large number, we can see that this objection, too, is not an insurmountable one.

"*Thirdly.*—A frequent objection that is made to these canes is the difficulty of milling them, on account of the higher fibre content, as compared with the native purple and striped canes. We do not consider that the higher fibre content is a disadvantage, in fact *we are inclined to esteem it a decided point in favour of the thinner canes.* In Table V[1] will be found the results of a series of analyses of the various varieties for the fibre contents, these figures showing that these canes run high—far higher than the canes of the place—in fibre. Every additional kg. of fibre which we have in our cane means that much less wood under our boilers; and that much money saved if we can get extractions from these canes comparable to those from the larger ones.

"Despite opinions to the contrary, which we have frequently heard expressed, we do not doubt that this can be done with a proper adjustment of the rolls, even if this should signify a slightly decreased grinding capacity, or, at least, that should these canes continue to prove a success, so comparable a quantity (of juice) could be obtained that the increased tonnage would more than repay for the slight decrease in percentage of juice which may result. We have made a considerable number of tests with a small electrically driven 3-roller mill, which gives us about 70 per cent. extraction with the native canes[2] and have found that even with the hardest of these canes, the Kavangire, we could get an extraction, without difficulty, within one or two points of that of the purple and striped canes of the country, and at the same time obtain a bagasse considerably drier than that from the native.[3]

"*Fifthly.*[4]—Most of these thin canes seem very much more free from the attacks of the borer (*Diatræa saccharalis*) and accompanying diseases than the heavier canes. This is probably due both to their small size and to their increased hardness."

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[1] Fibre content of the native cane average 10·6 per cent. and of Kavangire 13·1 per cent.

[2] By passing the bagasse through the mill once also, thus simulating the work of a 6-roller mill without crusher.

[3] We find, from official figures of the Java Experiment Station, that, in 1912, twenty-three factories had an average content of fibre in cane, during all the crop, of above 13 per cent. (the fibre content of the Kavangire), while seventeen worked cane with an average fibre content of less than 11 per cent. (more or less the fibre content of the Tucumán native canes). Now, condensing the figures for these two groups and making the averages for each one, the results obtained by the factories grinding cane with high and low fibre content may be judged by a glance at the following table:—

RESULTS OBTAINED IN JAVA FROM FACTORIES GRINDING CANE OF HIGH AND LOW FIBRE CONTENT.

Fibre in Cane. Per cent.	No. Factories.	Per cent Sucrose in Cane	Per cent. Sucrose extracted on 100 per cent. Cane.	Per cent. Juice extracted on 100 Pts Juice.	Per cent. Fibre in Cane.	Bagasse Data.		
						Per cent. Sucrose.	Per cent. Humidity.	Per cent. Sucrose lost.
Below 11....	17	12·59	11·49	91·3	10·58	4·72	48·45	1·10
Above 13 ..	23	12·25	11·06	90·3	13·61	4·29	44·99	1·18

There was little difference, then, between the results obtained by the two groups, the most important one, from the calorific standpoint, being that the bagasse from the high-fibred cane had 3½ points less humidity. The average per cent. sucrose in cane was slightly better in the group of the *ingenios* grinding low-fibred cane, and they obtained 1 per cent. more juice than the high-fibred group, and lost slightly less sugar in the bagasse.

[4].—"Fourthly" deals with increased frost resistance, a point of no importance in Porto Rico.

In regard to the latter point, the following data are interesting. In 1912, Mr. T. C. Barber, then Sub-station Superintendent of the Tucumán Experiment Station, made counts of the number of average canes of the native and Kavangire varieties in the Experiment Station plats, noting the number of invested joints as compared with the total number of joints in each lot. Table VII shows the results of these counts.

Table VII.

Infestation with the Borer.

Varieties.	Joints examined.		Per cent. Joints infested.
Native canes	1776	....	41·3
Kavangire	326	....	15·6

Table VII shows us that there is a tremendous difference in the infestation between the very thin Kavangire and the heavier native canes growing in close proximity to each other, the latter showing almost three times the number of infested joints that the Kavangire does. In view of the fact that the borer is indirectly responsible for many of the diseases of sugar cane, it may well be appreciated that this is no unimportant point in favour of the Kavangire.

Conclusions.

Most of the objections to this type of cane are based on conditions, then, that can be controlled—objections which have been accumulated in the Argentine when gradually replacing the native varieties by the new Java canes recommended and pushed by the Tucumán Sugar Experiment Station. The fact that the Kavangire is a late maturer in Tucumán has inhibited its use on a large scale in Argentina, but this factor would probably be of little importance in Porto Rico, where all canes have longer growing seasons than those of the sub-tropical Argentine sugar districts, with their long droughts and heavy frosts.

One point has not been mentioned by the Porto Rico investigators which is of capital importance—the quick inversion of the juice of the Kavangire once the cane is cut. This is a very pronounced phenomenon, with both the Java and Kavangire varieties, but is by no means an insuperable difficulty—in fact it has proved rather a blessing to the Argentine, having imposed better organization in the field and more prompt deliveries of cane to the mill, whereas, even though the native canes invert much less rapidly, much sugar was undoubtedly lost in the old days by carelessly leaving the cut cane four or five days in the field.

The stripping of this cane represents a real difficulty, as the leaf-sheath adheres very tenaciously to the stalk, and the adoption of Kavangire would inevitably bring an increase in the cost of harvesting, as the adoption of the Java canes in Tucumán has done, but this extra cost of crop is much more than recompensed by the reduced cost of cultivating this prolific and quickly-closing variety. If the Kavangire turns out to be the only variety in Porto Rico immune to the mottling disease, it will be adopted as the staple cane of the Island, and the economic conditions relative to its adoption will be worked out by its progressive scientists, growers and manufacturers just as they have had to be in Tucumán.

The young Tucumán Sugar Experiment Station has saved the Tucumán sugar industry from extinction—perhaps the bread it has cast upon the waters may be washed up manifold upon Porto Rico's verdant shores.

Two new species of Hydnoceae are reported by E. A. Burt [1] as having been collected on cane at Rio Piedras, P.R., by J. A. Stevenson, namely (1) *Odontia Sacchari* Burt n. sp., on the dead basal part of leaf sheaths; and (2) *O. saccharicola* Burt n. sp. on the living stems.

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[1] *Annals of the Missouri Botanical Garden*, (St. Louis) 1917, **4**, No. 3, 233-236.

The Water Content of True Final Cane Molasses.

By H. C. PRINSEN GEERLIGS, Ph.D.

Under the above caption we gave in the *International Sugar Journal* in 1918[1] a review of the methods to be used for finding the exact maximum water content to which a molasses has to be evaporated in order to attain the full crystallization of sucrose to which it is capable.

We outlined the analytical methods and stated (on page 217) that, owing to technical difficulties we had sent the apparatus to Java and recommended our Java friends to pursue the experiments. This has since been done by DR. VAN DER LINDEN,[2] who publishes the investigations made, in connexion with the study of exhaustion, with ten samples of cane molasses.

He describes his method of investigation as follows:—"The molasses was taken from the gutter under the centrifugals and, if necessary, concentrated in an ample flask under high vacuum at a temperature below 70° C. In case of the molasses containing minute crystals, which often occurred, these were first dissolved by addition of hot water and shaking, after which the diluted molasses was concentrated as above mentioned. Quantities of 150-160 grms. of this thick molasses were weighed in wide-necked stoppered bottles, and by the addition of various amounts of water, and the careful mixing of both constituents, a series of samples of gradually rising water content was obtained. Next 50 grms. of well-shaped pure sucrose crystals were added to each of the samples and well mixed with the molasses; after that the bottles were closed with rubber stoppers, which for better security were fastened with string. The bottles were fixed on a stirrer and kept in motion in a thermostat, the temperature of which was strictly maintained during 10 or 12 or even more days. After a time, when it might be assumed that equilibrium would have set in, the bottles were emptied on to a filter of centrifugal gauze and the molasses sucked off by an air pump. Filtration over cloth was of no avail, as it took far too much time. Of course filtration through the rather wide meshed centrifugal gauze had the disadvantage of allowing small sugar crystals to pass along with the molasses; but these very fine crystals also passed through linen cloth, so that even in this manner no perfectly limpid filtrate could be obtained. All experiments were made in duplicate and the crystallization was investigated both at 30° and at 50° C., the first temperature corresponding with that prevailing in sugar-houses and the second one with that at which usually the after-product massecuites are cured."

A serious impediment mentioned by VAN DER LINDEN, one that has caused the writer also very great annoyance and which is apt to render some of the results unreliable, is the very easy formation of very minute sugar crystals in the concentrated molasses, which still goes on crystallizing out. These crystals are so very small that they could not be separated by filtration. VAN DER LINDEN tried every method of filtration, but could not obviate the difficulty. It is evident that this fact influences here and there the results of the experiments, and VAN DER LINDEN mentions in a note that after his experiments were finished he learnt of experiments by KALSHOVEN,[3] showing the very great influence on analysis caused by sugar crystals embodied in thick molasses.

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[1] Page 214.

[2] *Archief voor de Suiker Industrie in Nederlandsch-Indie, 1919*, 1511.

[3] *Archief voor de Suiker Industrie in Nederlandsch-Indie*, 1919, 27, 1560 and 1700; *I.S.J.*, 1919, 608.

Notwithstanding the difficulties with the grain, and its influence on some of the results, VAN DER LINDEN succeeded in stating the exact concentration of the true molasses, which is of very great interest for practical work in the sugar-house.

He examined 10 samples of molasses; seven of these came from factories where the juice had been clarified by the common defecation process, two by the carbonatation process, and one by the sulphitation process.

The final results are collected in the table given here.

No.	Purity.[1]		Solid Matter.	Observations.
1 Defecation	Purity of original molasses	38·1	84·43	At 30°C. a further decrease in purity could be expected on continued concentration. The possible limit at 50°C. is to be expected at 35–36° purity.
	Lowest purity obtained at 30°C.	38·7	82·60	
	Lowest purity obtained at 50°C.	37·1	84·92	
2 Defecation	Purity of original molasses	30·9	81·95	The minimum purity at 30°C. lies probably between 28 and 29°. At 50°C. a lower purity may be expected on further concentration.
	Lowest purity obtained at 30°C.	30·1	84·82	
	Lowest purity obtained at 50°C.	32·4	85·35	
3 Defecation	Purity of original molasses	39·5	81·16	Both at 30°C. and at 50°C. a further concentration may cause a lowering of the purity.
	Lowest purity obtained at 30°C.	33·7	83·60	
	Lowest purity obtained at 50°C.	37·5	83·79	
4 Defecation	Purity of original molasses	41·7	85·70	Neither at 30°C. nor at 50°C. may a further decrease in purity be expected on continued concentration.
	Lowest purity obtained at 30°C.	38·3	84·17	
	Lowest purity obtained at 50°C.	39·1	84·29	
5 Defecation	Purity of original molasses	46·5	84·45	Both at 30°C. and at 50°C. a further decrease in purity is to be expected on continued concentration.
	Lowest purity obtained at 30°C.	39·6	82·15	
	Lowest purity obtained at 50°C.	40·3	81·91	
6 Defecation	Purity of original molasses	36·7	80·44	Both at 30°C. and at 50°C. a further decrease in purity is to be expected on continued concentration; at 50°C. still more than at 30°C.
	Lowest purity obtained at 30°C.	32·0	83·66	
	Lowest purity obtained at 50°C.	34·2	84·08	
7 Defecation	Purity of original molasses	45·5	81·45	At 30°C. no decrease below 40–41° is to be expected. At 50°C. a distinct decrease in purity may still be expected on further concentration.
	Lowest purity obtained at 30°C.	41·5	82·39	
	Lowest purity obtained at 50°C.	45·3	82·59	
8 Carbonatation.	Purity of original molasses	35·4	84·91	Neither at 30°C. nor at 50°C. may a notable decrease in purity be expected on further concentration.
	Lowest purity obtained at 30°C.	32·5	83·20	
	Lowest purity obtained at 50°C.	33·0	84·92	
9 Carbonatation.	Purity of original molasses	38·7	80·84	The possible minimum purity has been reached at 30°C. At 50°C. the formation of fine crystals prevented the determination of reliable data.
	Lowest purity obtained at 30°C.	35·6	83·15	
	Lowest purity obtained at 50°C.	—	—	
10 Sulphitation.	Purity of original molasses	44·6	83·64	At 30°C., as well as at 50°C., no decrease of any importance under 40° may be expected on continued concentration. At 30°C. it may, however, come down somewhat further.
	Lowest purity obtained at 30°C.	40·4	81·31	
	Lowest purity obtained at 50°C.	42·3	87·48	

In many experiments the concentration could not be carried further, because of the molasses foaming too violently; in others the fine crystals were formed to such an extent that the purity of the mother-liquor could not be ascertained with accuracy. In those cases, however, the course of the purities derived from the successful analysis could be traced so far as to allow one to judge whether, on continued concentration and full crystallization of the sucrose, which can crystallize out under the conditions, a further decrease in purity may still be expected or not; in the latter case the constitution of the real exhausted molasses is reached.

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[1] The quotient of purity, in this article abbreviated to "purity," is the true one, viz., the relation between sucrose and actual solid matter.

The first conclusion derived from these analyses was that in every case the molasses from the usual working in the factory had not been worked to the state of full exhaustion, although in the case of 1, 2, 4 and 8 the difference was very small indeed. We must bear in mind that in such laboratory experiments a much greater delicacy can be maintained than in practical working, so that it could not be expected that the molasses from the factories were as completely exhausted as corresponds with the theoretical possibility. Considering this truth, a difference of a few degrees of purity, especially in such low-grade molasses, might pass as practically non-existent.

The experiments confirm again the facts so often repeated by us for so many years, viz., that the constitution of certain molasses presents an obstacle to their being exhausted to the same extent as some others are, which means that the constitution of the non-sugar is a very prominent factor in the degree of crystallizability of the sucrose from molasses. Nos. 4, 7, and 10 could not be exhausted further than to 40—41°, whereas in the No. 6 series the lowest purity was not reached at 32·0 and 34·2 at the two temperatures respectively, and with sample No. 2 the lowest purity could be taken as 30·1.

We give here the constitution of the five samples of molasses picked out of the ten under consideration.

	Low purities.		High purities.		
Constituents.	2	6	4	7	10
Degrees Brix	86·36	83·74	91·60	85·09	89·15
Solid matter	81·95	80 44	85·70	81·45	83·64
Polarization	22·07	27·00	33·00	30 72	33·06
Sucrose	25·34	29·55	35·74	37·02	37·37
Reducing sugar	34·90	31·63	22·10	18·48	25·86
Purity $\frac{\text{Polarization}}{\text{Brix}}$	25·6	32·2	36·0	36·1	37 1
,, $\frac{\text{Sucrose}}{\text{Brix}}$	29·3	35·3	39·0	43 5	41·85
,, $\frac{\text{Sucrose}}{\text{Solid matter}}$	30·9	36·7	41·7	45·45	44·6
,, Minimum	28·29	32·0	38·3	40·41	40·0
Gum	1 33	1·12	1·45	2·00	0·74
Ash	7·08	5·98	9·07	9·63	8·02
Soluble part of the ash	4·17	3·18	6·06	7·05	6·10
Insoluble part of the ash	2·91	2·80	3·06	2·58	1 92
Iron oxide, alumina, and calcium phosphate.	0·64	0·51	0 47	0·71	0·15
Lime otherwise combined	0·72	0·82	1·14	0·50	0·69
Magnesia	0·12	0·30	0·10	0·31	0·24
Potash	2·31	1·72	3·62	3·89	2·97
Soda	0·25	—	—	—	—
Silica	0·76	0·66	0·65	0 62	1·55
Sulphuric acid	0·68	0·98	0·51	1·10	1·55
Carbonic acid in the ash	1·68	1·04	2·25	1·93	0·96
Chlorine	0 28	0·33	0·47	0·33	1·03
Organic non-sugar	14·63	13·28	18·79	16·32	12·45
Ratio of Reducing Sugar : Ash	4 93	5·29	2·44	1·92	3·22

This table again shows that, in general, a high quotient between reducing sugar and ash coincides with a low purity, and *vice versa*. No. 10 appears to be an exception to this rule, but the salt in that molasses had a quite different constitution from those occurring in the other samples. The latter contained far more salts of organic acids, as is shown by the large amount of carbonic acid in the ash, while in the constitution of the salts of No. 10 those of inorganic acids prevail. In correspondence with this fact, we find the organic non-sugar of No. 10 existing to a much lower extent than in the others.

When comparing in the first table the lowest obtained purities with the corresponding figures for solid matter, it will be seen that the most useful amount of solids appears to be around 85 per cent., a figure which in the original samples was found with the numbers 4, 5 and 8.

In the factory the full amount of exhaustion was not yet attained at that concentration in the case of the two former ones, for the purity of No. 4 could still drop by 3·4 degrees, and that of No. 5 by even 6·9; but in sample No. 8 the lowering of the purity could not go beyond 2·9 degrees. It is true that such decreases and even still smaller ones were equally met with in the samples having a lower amount of solid matter, as for example in No. 1, where in the original molasses a purity of 30·9 had accompanied a solids content of 81·95, and this purity could not be induced to fall perceptibly, even after concentration to a percentage of 84·82 solid matter. In sample No. 10 we noticed actually the reverse; the original molasses had possessed a purity of 44·6 with a solid content of 83·64 per cent., and it could be reduced to a purity of 40·4 notwithstanding that the solids content was only 81·31, so that in this case a higher water content had accompanied a lower quotient of purity.

The better exhaustion, owing to crystallization, is therefore not dependent alone on the evaporation of water, for otherwise there would be no limit to the crystallization and the lowering of the purity so long as evaporation had not changed the molasses into a solid block. According to the data in the table, the limit for crystallization was in many cases attained while the molasses was still liquid and contained yet a good proportion of water.

This investigation leads to results which are quite contrary to the theory not long since published by J. N. S. WILLIAMS in the *International Sugar Journal.*[1] He comes to the conclusion that the only agent in a molasses which keeps sucrose from crystallizing out is water, so that every part more of water evaporated allows more parts of sucrose to crystallize out. The investigations made by DR. VAN DER LINDEN corroborate my statements that beyond a certain limit further evaporation will merely have the effect of rendering the molasses more viscous, but will not induce any more sucrose to crystallize out. We have considered it always to be of very great importance, from a practical point of view, to know where that limit lies, in order to prevent evaporation from being conducted too far, thereby preventing the molasses becoming too sticky and too adherent to the crystals.

In the analyses given above we find the optimum quantities of solids in the different experiments to be as follows, with the figures for relation between sucrose and water added as a comparison:

No.	Solid Matter.	Water.	Sucrose on 100 water.	Non-sucrose on 100 water.	Purity.
1	82·60	17·40	169·0	251·0	38·7
2	84·82	15·18	168·0	391·0	30·1
3	83·60	16·40	171·4	338·4	33·65
4	84·47	15·53	208·1	335·8	38·3
5	82·15	17·85	178·4	281·8	38·8
6	83·66	16·34	164·0	393·0	32·0
7	82·39	17·61	194·0	273·8	41·5
8	83·20	16·80	161·0	334·2	32·5
9	83·15	16·85	175·5	323·1	35·5
10	81·31	18·69	175·8	259·2	40·4

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[1] 1917, 90, 297 and 568.

We should not forget that in these experiments the water content is apt to be on the low side, as in every instance the purities were determined after very advanced concentration, which might cause the evaporation to be conducted somewhat too far.

In the writer's publications of 1895, which are quoted in his book, "Cane Sugar and its Manufacture," it was stated on page 330 that in a molasses of about 30° apparent purity (equal to 35° true purity) the relation between sucrose and water oscillates between 100:130 and 100:160, or slightly less than the figures derived from the experiments referred to here. In an earlier article under the same heading as the present one[1] he derived from a series of molasses obtained in modern work figures leading to the conviction that a solids content of 84, or a water content of 16 per cent. was the best for obtaining total exhaustion, in which case the relation between sucrose and water is as 100 : 164-175. It will be seen that these figures fully agree with those of VAN DER LINDEN, so that a good concordance has been established between figures from the laboratory and factory.

The explanation why these newer figures are somewhat higher than those the writer compiled 25 years ago[2] may be twofold. The first reason is that the earlier investigations were made with massecuites boiled string-proof and crystallized out as far as possible at rest, while the modern ones are boiled to grain and highly concentrated, which may cause the evaporation to be conducted over the point of the theoretical water content; likewise the massecuites were centrifugalled after a few days. The second reason, which may be traced back to the same cause, is the fact that the molasses from the last massecuites boiled to grain may contain a rather large amount of fine sucrose crystals, while those boiled string-proof and allowed to cool and crystallize for some months are free from this admixture. In the publication relating to the experiments of 1895, the writer stated expressly that among the many samples of molasses those were picked in which the suspended crystals had been allowed six months' time to deposit themselves, thus leaving the molasses limpid and free from undissolved sugar.

This has very probably not been the case with the newer molasses, for it appears from experiments published by KALSHOVEN[3] that nowadays the final molasses generally contain largely differing amounts of fine sugar crystals which cannot be separated by filtration and under the usual analysis are reckoned to be dissolved. It is therefore quite possible that the molasses of later years and those studied by VAN DER LINDEN have contained, over and above the quantity of sucrose dissolved, still larger or smaller amounts of undissolved sucrose, which helped to increase the proportion between water and sucrose as compared with the older ones.

The figures collected by KALSHOVEN, which are published in the two papers just mentioned, show that in 88 samples analysed the amount of fine crystals oscillated between 0 and 17·7 per cent. causing the purity to increase by amounts ranging between 0 and 13·95 degrees. It is evident that when ascertaining in a molasses, containing 10 and more per cent. of fine grain, the relation between water and sucrose, a much larger figure is obtained than when the crystals have been allowed to settle and the supernatant molasses has been analysed.

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[1] *International Sugar Journal*, 1918, 214.

[2] "On the Influence of Glucose in the Formation of Molasses." *Sugar Cane*, 1895, 293, 362, and 404.

[3] *Archief voor de Suiker Industrie van Nederlandsch Indië* 1919, 27, 1560 and 1700; *I.S.J.*, 1919, 608.

The figures for the difference in purity between molasses with and without grain in the 88 samples investigated may be divided as follows :—

13 samples showed differences from 0-2 per cent.
22 " " " 2-5 "
32 " " " 5-10 "
21 " " " 10-14 "
—
88

The fact that in so many modern molasses huge quantities of fine crystals are found to occur leads us back to our observation that the exhaustion of the molasses is not a mere consequence of evaporation or even of aptness to crystallize. It results likewise from the experiments that the shape in which crystallization takes place has at least as much influence on the yield of massecuites and the purity of the molasses as has the quantity of sugar crystallizing out. When one bears in mind how great an importance is attached to the figure of purity in exhausted molasses, so that even fractions of a degree of purity are considered worth while taking into account when comparing the merits of two different factories or methods, it is rather surprising to find that differences of 10 to 14 degrees in purity, only occasioned by defective crystallization, escape notice. Those big differences, which are at the same time losses, could have been avoided if the crystallization of the sugar had been conducted in such a manner that the particles of sugar crystallizing out had found sufficient space on the already existing crystal planes to deposit themselves and, moreover, had been allowed the necessary time to do so. This observation is by no means new. Already as early as in 1895 we summed up our conclusions in an article[1] on "The Centrifugal Outcome" in these words: "The experiments show that the outcome depends not only on the quantity of sugar present in the massecuites, nor yet only on the quantitiy of crystals it contains, but also to a large extent on the shape of the sugar crystals." It is not encouraging to find that 25 years afterwards this same warning has to be repeated when discussing the yield in crystals of after-product massecuites, which are found to give final molasses of 38·95 degrees purity, when with a better use of the sugar machinery in existence it would be possible to work it down to a purity of 25 degrees.

More than twenty years ago we advocated crystallization in movement and the returning of molasses, all with a view to improving conditions for the crystallization of sugar into well-shaped crystals; but now it seems as if much of the advantages gathered by these processes has been allowed to get lost.

The question is simplicity itself. When making the massecuites, so that by addition of final molasses in after-product boilings a good fluidity and circulation are obtained and maintained at the moment that the necessary amount of water has been driven off to allow all of the free sucrose to crystallize out, the massecuite should after being struck be kept hot and in steady movement till the sucrose has profited by the opportunity to settle on the existing crystals. The impurer the massecuite is, the more time it takes for the sucrose to crystallize out, so that a spacious cooler capacity is needed to allow the sucrose to crystallize as fully as possible before the molasses are cured off.

Only if the necessary time has been allowed can full success be expected. Kalshoven states in his report that microscopic inspection showed the sugar crystals in the final molasses to have been formed after the molasses had been cured off, which points to defective boiling and cooling.

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[1] *Sugar Cane*, 1895, 182-195

Hence we may well ask ourselves the question whether in modern practice too much of the yield has not been sacrificed to the eagerness for rapid output. When the advantages of some kind of vacuum pan are cited, the usual eulogium is that it allows the boiling to be done very quickly and we hear many a time of a man praising his pan, for finishing a massecuite in a quarter of an hour's time less time than some other pattern, just as if quickness were the chief factor in boiling sugar. The same thing may have been the case with the cooling, for we know instances where crystallization-in-motion which was originally planned as a means of improving the shape and amount of sugar recovered from the massecuite has been degraded to a mere cleanly and speedy manner of transportation of massecuites.

It is evident that part of the sugar capable of crystallizing out when the water is evaporated (but as a consequence of the high degree of viscosity forced to do so slowly and not given the necessary time) remains still in the molasses at the moment it is spun off and only later on crystallizes out in the shape of very minute crystals. When by doing so, final molasses is obtained containing up to 14 per cent of sugar crystal (which, owing to its small dimensions is to be considered as a direct loss) it does not need to be wondered at that Mr. AGEE and Mr. NORRIS[1] can find by microscopical inspection sugar crystals in solidified Java molasses.

The latest investigations show clearly that we do not want to change anything in our theories. If one wants to obtain really exhausted molasses which cannot give up any more sugar by further evaporation, it is only necessary to get a final massecuite of about 60° apparent purity and concentrate it till the solids content of the cold molasses is about 84 to 85 per cent. After striking, keep the massecuite for at least three or four days in movement, only very slowly cooling, and cure it in the centrifugals at a temperature of about 45° C.

As a check on the total crystallizing out, the molasses should be inspected by the refractometer directly after curing and a week later. If the refractive index remains the same, there has not been any after-crystallization and nothing ought to be changed, but if the later figure is lower than the earlier it is a sign of after-crystallization of sucrose from the molasses, and the cause ought to be investigated. Either boiling or cooling, or both, have been too rapid, and it is the task of the sugar chemist to ascertain the cause and remedy it.

According to an American consular report the production of sugar in the Province of Tucumán is estimated to reach at least 200,000 metric tons, and that of other sugar-growing Provinces—Jujuy, Salta, Chaco, Corrientes—to about 50,000 metric tons. If to this total 250,000 metric tons there be added the surplus of 40,000 metric tons of sugar imported free of duty, the country possesses an available and prospective stock of 290,000 tons for its needs during the present industrial year. As those requirements are estimated at 200,000 to 210,000 tons, there will be an eventual surplus of 80,000 to 99,000 tons.

Since we published last month Willett & Gray's estimates of the world's sugar crops, that firm have amended the figures of several countries ; Porto Rico promises 426,631 tons instead of 400,000, Hawaii 500,000 instead of 560,000 tons, Demerara 80,000 instead of 100,000 tons, and Germany 1,000,000 instead of 1,300,000 tons. The world's total for 1919-20 is now estimated at 16,389,394 long tons, a decrease as compared with 1918-19 of 29,186 tons.

The Italian beet crop has proved a favourable one ; the area planted in beets was about 148,000 acres or a larger surface than that of any year since 1913 when 152,700 acres were planted. The amount of sugar produced is expected to reach 150,000 tons, as compared with 100,000 tons in the previous two seasons.

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[1] *I.S.J.*, 1918, 328.

Report on Evaporation and Boiling in Hawaii.[1]

By H. D. BEVERIDGE.

Twelve questions relating to evaporation and boiling were submitted to members of the Hawaiian Chemists' Association, and the following is a digest of the replies received:—

1. What type of evaporator, including pre-evaporator, do you consider the most efficient and economical for raw sugar-house work? Give reasons.

The majority were in favour of the "standard" vertical submerged type, on account of its lower cost, simplicity, accessibility for repairs, and its ease of operation and keeping clean. Mr. J. W. DONALD notes that the film type of evaporator with forced circulation has the highest place in efficiency, but prefers the standard type for the above reasons. Mr. J. P. FOSTER prefers the Kestner for pre-evaporator, for the reason that steam of 40 to 50 lbs. pressure can be used with safety, and vapours of high pressure can be removed for use elsewhere. Mr. H. S. WALKER believes an evaporator having a large enough first body to take the place of a pre-evaporator would be a good arrangement.

At Papaikou there is a pre-evaporator of 4 cells that can be used separately or as one unit. It has approximately 1000 sq. ft. of heating surface per cell, or 4000 sq. ft. in all, one body of which is idle; one second effect of 12,000 sq. ft. heating surface, which gives a total heating surface in pre-evaporator and quadruple of 15,000 sq. ft. for the 1919 crop. There was evaporated from juices exclusive of wash-water from presses (of which we have no authentic data) 5·2 lbs. of water per sq. ft. heating surface per hour, besides which mixed juices were heated to 215-220° F. These evaporators are all automatically controlled, so that little variation of the level of liquors in the different bodies occurs, an important factor.

2. In terms of tons of cane per hour, using 40 per cent. dilution and 4 to 6 lbs. steam pressure, how many sq. ft. of heating surface should an evaporator contain (including pre-evaporator) to deliver syrup at 70° Brix?

Answers indicated that a pre-evaporator should have 80-85 sq. ft. per ton per hour; a triple 240; and a quadruple 320. This the writer believes to be ample.

3. What do you consider the limit of concentration of cane juices to syrup, in the making of good-grained sugar? Give reasons.

Answers to this question were various and ranged from 60° to 75° Brix. Mr. R. C. PITCAIRN believes the limit is that point where syrup can be grained quickest in the pan without the use of water. Mr. E. T. WESTLEY believes up to 75° Brix the limit; Mr. R. J. RICHMOND says 60° to 65° Brix, but that if fuel is no item, 50° to 54° would make a better-grained sugar. Mr. J. E. BIELA does not hesitate to state that any high density within the safety limit of not crystallizing in the evaporator, will produce good-grained sugar by careful pan-work. Mr. H. S. WALKER says 70° Brix; it will require more care and time in boiling, but it can be done. Mr. H. JOHNSON says 65° Brix; and that with higher Brix the pan-men are apt to use too much water in their endeavour to make good-grain sugar. Mr. W. K. ORTH believes in a high purity of syrup of 70° Brix, and slow boiling. Mr. J. P. FOSTER says the limit of concentration is just below that point at which microscopic crystals will form in the tank when the syrup cools, also a low-purity syrup can be boiled heavier than a high-purity syrup. The writer believes that concentration in the multiple-effect evaporators to as high a density as is possible is very important, more particularly where fuel is scarce and auxiliary fuel has to be used; and that 1° Brix gained in the effect means a large saving of steam in the pans. He considers with careful pan-work, good-grain sugar can be made from syrup of 70° Brix or over without the addition of water in pans and at a large saving of fuel and time.

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[1] Paper presented to the 17th Annual Meeting of the Hawaiian Chemists' Association.

4. Which of the methods of starting molasses syrup strikes to make a 96·5° sugar do you prefer, whether (*a*) grain started from syrup; (*b*) grain started from low-grade sugar; or (*c*) method of starting grain? Give reasons in each case.

Most of the replies were in favour of "seeding" massecuite with low-grade sugar as the most economical, although a few preferred to grain from syrup on account of the liability of dark seed grain in low-grade sugars. We have practised seeding with second sugars mixed with syrup for several years and regard it as a simple and economical way to dispose of part of the low-grade product. The low-grade sugar is dropped directly from the centrifugal baskets into a tank fitted with stirrers. It is there mixed with syrup to 90° Brix and pumped by a magma-pump directly to a mixer on the pan floor. If there is more syrup-sugar mixture than is needed for seed, the procedure at Papaikou is to draw a part into the pan and melt, then taking the usual amount for seeding purposes. This hastens the pan-work.

5. Do you know of any method of boiling and curing syrup-molasses strikes of 94°-96° Brix; 76°-78° apparent purity; 96·0°-96·5° polarization; and of preventing such sugar from caking in the bags, when the massecuite is cured hot, and the sugar bagged and piled without cooling off? Please describe in detail.

All the answers were in the negative. At Onomea during the last season particularly, there was a lot of trouble with caking in the bags. Conditions were as described in the question. The sugar went to the pile at 48° C. and was never moved again until shipment. It was found on shipping that this sugar had caked hard, which makes it difficult to handle and is destructive to the bags. Cooling appears to be the only known remedy.

6. Describe your method of graining and boiling second massecuite strikes; also the time of boiling the Brix, and the apparent purity of the finished massecuite.

Most methods described were those familiar ones. Mr. ORTH seeds his low-grade strikes with sugar-dust.[1] There has been a great improvement in the final molasses of many plantations this year, without doubt the result of better low-grade pan-work. When the equipment allows, two boilings should be sufficient to exhaust the molasses further than we have yet reached. Hence it is quite important that the second-grade pan-work should be carefully and intelligently conducted. We should strive to make a grain of sufficient size and evenness to build our first sugars on, not too large, else the molasses will not be properly exhausted.

7 and 8. Give the number of days second massecuite requires to remain in the crystallizer or coolers before crystallization is complete. Give data covering the daily drop in purity of second massecuite molasses till exhausted.

Most answers were governed by the low-grade crystallizer capacity, but generally the time indicated ranged from 8 to 10 days up to three weeks, according to the time taken to reach atmospheric temperature. Mr. WALKER and Mr. PITCAIRN have each contributed some valuable data covering this question in the shape of charts showing the daily drop in apparent purity of second massecuite, also daily drop in temperature.

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[1] *cf.*, H. E. ZITKOWSKI, *I.S.J*, 1919, 36.

9. What disposal do you make of second sugar? Give reasons.

Whereas a few remelt their second sugar entirely to get rid of the dark seed grain, the majority use what they can for seed and remelt the remainder. This seems the more economical procedure?

10. Do you make second sugar and final molasses, or third massecuite? What disposal do you make of your third sugars?

All not making second sugar and final molasses, remelt the third sugars.

11. Do you have any trouble with second or third massecuite swelling or foaming in the crystallizers or tanks? Give the cause and its prevention.

Some members report no trouble from low-grade massecuite foaming in the containers, always allowing room in the receiver for this. All agree that the cause is too high a pan temperature before striking, effecting decomposition, and the remedy obviously is to cool off the pan before dropping the strike.

12. Describe anything new or of interest on the above subject.

Mr. Orth notes that the seeding of low-grade massecuites boiled to string proof with sugar dust shortly before dropping the strike makes for the better desaccharification of low-grade massecuite. Mr. Westley mentions that during the last season at Paauhau they have remelted and returned all low-grade sugars to the mixed juices; they have thus boiled their second and third massecuites from higher purity and have raised the Brix of the third massecuite from 93° to 95°. This method has given them a better purging massecuite and lower waste molasses than ever before.

I believe some of the plantations are changing their coil-vacuum pans to calandria pans. It would be interesting to hear why such changes are being made. At Onomea, in 1898, we installed a 25-ton calandria pan which has given excellent satisfaction this last year.

Steam Pressures and Temperatures in the Sugar Factory.[1]

By ALEX. G. BUDGE.

The ordinary pressures heretofore maintained in sugar factories have been limited to 125 lbs. per sq. in. and under, and the great majority of our sugar factories are operating on pressures of approximately 100 lbs. Pressures such as these are ordinarily called low, in contrast with those above 125 lbs., which are ordinarily termed high. High-pressure steam is usually obtained from boilers capable of operating at 160 lbs. pressure. But in ordinary power-plant practice, a pressure of 160 lbs. would be termed low and pressures over 200 lbs. high, which is an indication of the general practice and terminology throughout the country.

In a well-balanced sugar factory all the exhaust steam is used for the evaporators and pans, so that when low-pressure steam is used for the engines there is no waste due to poor economy of engine operation with this low-pressure steam.

It is the general opinion that in a factory in which exhaust steam is blown to the atmosphere and live steam is taken from the boilers for boiling-house purposes, the control is very poor, and that this waste of exhaust could be eliminated. There is, at present, a tendency in factories to install turbines and electric drives, and this tendency is growing, with the probability that in the next ten years electrification will be utilized in a great many of the sugar factories in the Hawaiian

Islands. Where a turbine is used to drive a generator or shredder, the cost of the power in pounds of steam becomes an item of importance in the balance of the factory, due to the poor economy of steam turbines when operated with low-pressure steam; so that where turbines are installed, or are apt to be installed, the steam pressure available should be, for the most economical operation, 150 lbs. or higher. By operating with a high pressure, the cost per horse-power in pounds of steam at the turbine is reduced, so that there is no danger of wasting the exhaust, which is very apt to be the case if the operating pressure is about 100 lbs. per sq. in.

In factories where steam turbines are not installed, or where the engines operate on low-pressure steam, it has been noticed on several occasions that the work is much more difficult to perform than where pressures of 125 lbs. or higher are available. The experience of engineers who have installed high-pressure boilers and have used this steam on their engines at 125 lbs. to 135 lbs. pressure has been such as to indicate far greater ease of operation and better economy as to fuel, due to the fact that at these pressures the power developed by the engine is sufficient to overcome any irregularities in the load on them which are the cause of trouble when operating at lower pressures. This high-pressure steam can be used on all the prime movers in the factory, and it is found that the operation throughout is generally more satisfactory.

A certain amount of live low-pressure steam at about 50 or 60 lbs. is required by many boiling-houses, and this can be obtained from the high-pressure boilers through a reducing valve without loss in economy. The reducing valve has the drawback of requiring a certain amount of attention; but, on the other hand, it favours the operation in that no loss of energy occurs by its use and the steam furnished to the boiling-house is dry and in some instances superheated; that is, the decrease in energy due to the drop in pressure is utilized in drying the steam, which reduces the amount of water to be handled by the traps, pans, and evaporators.

The question of the advisability of superheat in a sugar factory is open to a great deal of argument; and unless there are turbines or engines in connexion with the factory for the generation of power to be used for outside purposes, it is not considered advisable to install superheaters.

The use of superheated steam in power-generating plants is an admitted economy, but if superheated steam has to be used in a boiling-house in the evaporators and pans, it is probable that the evaporators and pans will not do as satisfactory work as with dry saturated steam, due to the poor conductivity of superheated steam and the liability of getting the juices or syrups too hot.

It would seem advisable, therefore, to install so-called high-pressure boilers capable of operating at 160 lbs. pressure, which is a standard pressure, and to operate them at 135 or 140 lbs., using this steam on the engines and prime movers, securing the low-pressure steam required through a reducing valve on the boiling-house lines. This would thus give an installation capable of effecting the maximum economy as to prime movers, together with the most satisfactory operation, and of maintaining this pressure over an indefinite period of years, providing the boilers are given proper supervision and care.

The second sugar cane forecast for the 1919-20 sugar crop in British India, as issued by the Department of Statistics at Calcutta, calculates the acreage under cane at 2,709,000, is compared with 2,590,000 in the previous crop season, or an advance of 5 per cent.

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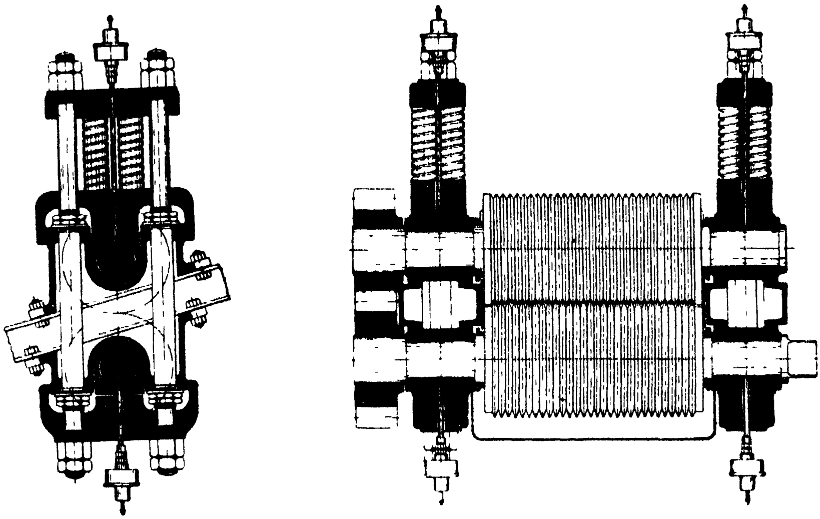
[1] Paper presented to the 17th Annual Meeting of the Hawaiian Chemists' Association.

The "Acme" Patent Two-Roller Sugar Cane Mill.

As may be seen on reference to our advertising pages, The Sugar Cane Appliances Co., Central Chambers, 11, Bothwell Street, Glasgow, have undertaken the commercial development of sugar cane mills, with the rollers operating in pairs, thereby eliminating the trash-turner. Previous experiments with mills of this type have never proved satisfactory, but in this instance, all difficulties seem to have been overcome.

It would appear reasonable to conclude that the crushing of cane can be effectively performed by passing it successively between two rollers, provided that the distance of these apart, and the pressures exerted, are suitably regulated. In three-roller practice, it is commonly accepted that the crushing is done between the rollers, but this point is disputed by the Sugar Cane Appliances Co., who claim that the vital crushing is done between the top roller and the trash-turner, at the expense of great and unremunerative power.

In the "Acme" two-roller mills the rollers are accurately grooved with annular V-shaped grooves, intermeshing with each other, the pitch of the grooves being reduced for the later and final crushing. The pressure between the rollers is regulated by springs over the top bearings, so that in case of an abnormal feed the top roller will rise slightly. At the same time the pressure will automatically increase or decrease, according to the thickness of the blanket passing through.

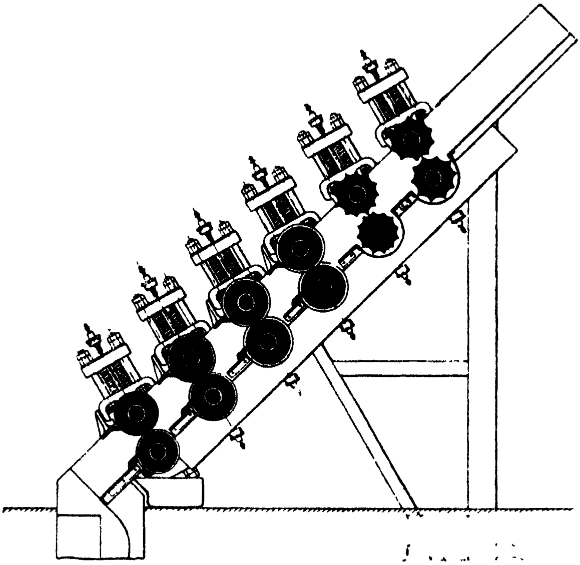


Cross Sections at Rollers.

The most distinguishing feature of these mills, however, is the system adopted, and patented, for carrying the bearings of the rollers. These are attached to the upper and lower flanges respectively of mild steel channels, set up at the requisite angle to secure an easy descent of the bagasse from one pair of rollers to the next, without the necessity of carriers. The channels are placed far enough apart to allow the through bolts, that take the pressure between the rollers, to pass between them. By this means the whole of the pressure is taken up by the bolts, the side strain on the bearings being negligible in practice.

The accompanying illustrations will assist one to understand this novel construction, and it will be seen also that the top roller is slightly inclined towards the feed chute. This has been found to be an advantage. The difficulty hitherto with two-roller mills has arisen apparently from their inability to take the feed properly, but in the case of the "Acme" mill this has never been experienced, due to this inclination of the top roller, combined with the gripping effect of the grooves and the elasticity of the springs.

The bearings may be made of light construction, and the rolled steel channels supporting them weigh less than the ordinary massive headstocks in use. This combination results in the total weight of the mill being considerably reduced, and as the best practice now-a-days is to substitute rolled steel sections for cast metal wherever possible, the primary cost of the mill is substantially lowered.



SIDE ELEVATION.

This, of course, must be considered in relation to the work which such a mill is capable of performing, and upon that point the information which the Sugar Cane Appliances Co. can furnish is satisfactory, though not extensive. The patent was granted after war broke out and progress was hampered thereby, but a small mill was installed in a factory in Cuba. There are ten rollers in this mill, or five pairs, each roller being 7½ inches diam. by 9 inches wide. The work done is 1·4 tons of cane per hour, and the weight of juice obtained is 77 per cent. of the weight of the cane. The power necessary to accomplish this is about 5 B.H.P.

It might be contended that results from such a small plant are unreliable, but the makers point out that in three-roller practice the work of a mill, no matter of what size, closely conforms to the rule that the output varies as the square of the diameter of the rolls multiplied by their length. This formula may be applied also, by fair reasoning, to the output of two-roller mills, in which case it will be found that their capacity is enormously increased in comparison with that of a three-roller outfit.

Not only is the reduced cost of these mills a satisfactory item in these days of expensive machinery, but the saving effected in power, due entirely to the absence of the trash-turner, is one of the utmost importance to many factory proprietors. It means that a considerable proportion of the steam expended in power will be available for evaporating purposes, with the result that there should always be a surplus, without the aid of fuel to supplement the bagasse.

We think sufficient facts have been placed before our readers to awaken their interest in this improved adaptation of the two-roller mill, and for further particulars we would refer them to the firm mentioned above, who are in a position to supply direct, or to grant licences to manufacture.

American Commerce Reports.[1]

THE SUGAR INDUSTRY OF THE PHILIPPINE ISLANDS.

The sugar industry in the Philippine Islands is attracting increased attention amongst manufacturers and capitalists. For many years past the average Philippine planter has been content with the old-style methods, and the consumer was satisfied with the *muscovado* and *pilon* products of these methods; but that time has passed and every up-to-date planter is now convinced that it would be vastly to his advantage to have his cane made into centrifugal sugar, and so he is ready to cooperate in the establishment of a central in his neighbourhood by entering into the usual contract for the delivery of his cane to the factory. Since, however, the tendency in the islands is towards the separation of the agricultural from the manufacturing branch of sugar production, a big demand has arisen for outside capital in order to supply the necessary equipment for the manufacturing end.

During the past year 18 modern mills produced for export 64,018 metric tons of centrifugal sugar, as against 47,224 tons exported in 1917, at an average price for 1918 of $91 60 per ton. During the same year 209,240 tons of muscovado sugar were exported, compared with 158,685 tons for 1917, at an average price of $42·60 per ton for 1918.

Heretofore the planters have made a fair profit on muscovado sugar when their product has been up to grade, but where the product has been inferior the prices obtained have hardly paid the cost of production. It is estimated that the cost of producing the cane for a picul (137·5 pounds) of sugar is $1, whereas the cost of maufacturing the cane into sugar by the old methods, furnishing sacks, and otherwise preparing the product for market is placed at 50 cents. The cost of shipping to market, allowing for insurance and depreciation, added to this, brings the estimated cost of a picul of *muscovado* or *pilon* sugar up to $2, and when it is remembered that the 3-roller mill employed leaves approximately 50 per cent of the juice in the cane, it will be seen that the cost to manufacture centrifugal sugar, even by contract, is practically no more than the cost to make *muscovado* or *pilon* sugar, whereas the prices obtained for the former are double those obtained for the latter. This difference in price, and the further fact that the cost of producing muscovado sugar has advanced more quickly than its market price, form the convincing argument that has turned the thoughts of sugar planters to the central. Moreover, the Chinese market for muscovado sugar has been waning in recent years, and a preference has been shown there for Philippine centrifugal sugar of 96° polarization.

One enterprising manufacturer of sugar machinery, who recently opened an office in Manila, has sent his experts to the islands to study the needs of the field, and is adapting his machinery, which was designed primarily for other sugar-growing countries, to meet the requirements of the Philippine market. It is probable that there will continue to be a market in the Philippines for small centrifugal mills of from 500 to 1,000 tons daily capacity. This type of mill appears to be best suited in point of cost and availability to the large plantation owner who desires to mill his own crop and, perhaps, that of his neighbour. A tendency is to be noted on the part of the planters in some neighbourhoods to unite in the purchase of a mill to be as centrally located as possible. The land in some sections of the sugar regions, however, is divided into such small holdings that the only feasible way to give these small planters the advantages of the modern mill is through the large central, with its contract system and provisions for transportation.

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[1] Culled from "Commerce Reports," published by the Department of Commerce, Washington. In many cases these are abbreviated here.

Such a sugar central in the Philippines should have an office staff, consisting of a superintendent, who is generally paid from $3000 to $4000 per annum; an assistant superintendent, $2000 to $4000; a chief chemist, $2000 to $3000; and four assistant chemists (usually Filipinos), $50 per month. The ordinary labour required during the milling season is a night and a day shift, each of 50 to 75 men. It is generally considered that 50 labourers are sufficient for a mill with a capacity of 800 tons daily. The San Carlos Mill, which now has a capacity of 1,800 tons daily, employs 160 workmen. Labour of this sort is generally paid from 35 to 60 cents per day without subsistence.

Men for the office force would probably have to be obtained outside the Philippines, in most cases. There are few engineers and chemists in the islands capable of operating centrals. The Filipinos are undoubtedly capable of acquiring the necessary training and experience, but modern sugar mills have not been in operation long enough in the islands to develop a supply of trained men to operate them. A number of Filipinos are now taking courses in chemistry and engineering in the United States and Europe, and these will doubtless help to supply the need in a few years. Just at the present there are good openings in the islands for men who have had training and experience in the manufacture of centrifugal sugar.

The ordinary labour required is usually easily obtained, although it is often difficult to get cutters to harvest the cane crop and labourers to work about the old-fashioned sugar mills where the muscovado and pilon sugar are made. The explanation seems to be that wages paid by the central are usually a little higher than those paid for field labour or by the muscovado mills. These men are for the most part inexperienced in the work required about a central and, therefore, are not very efficient, but the supply of experienced labour is increasing each year. As new centrals are established workmen employed in some of those that have been operating for some time seek employment in the new enterprises in the hope of bettering their situations or for the mere desire to try something new, while new men take their places in the older factories.

Mr. CLEVE W. HINES, formerly sugar technologist of the Philippine Bureau of Agriculture, estimates that the buildings and machinery for a mill with a capacity of 800 tons per day would cost about $25,000. In this connexion it should be remembered that cement and construction steel cost nearly 100 per cent. more now than they cost before the war. The San Carlos central, including machinery and building material, was erected at considerably greater cost than it would have been before the war. Structural steel that before 1914 cost about $43 per metric ton now approximates $81, though with a tendency downward; corrugated iron roofing that cost $67 a ton in pre-war days now brings $150; cement has risen in this same period from $8 per ton to $12. Lumber and all builders' hardware have gone up proportionately.

Machinery imported from the United States into the Philippines pays no duty. It costs about as much to lighter or land freight in Manila as it would cost in an American port. Apparatus is not available for handling extremely large pieces. It must be borne in mind, however, that the points where the machinery is to be installed are usually far from Manila, and there are few facilities for loading and unloading heavy machinery in most of these places. Machinery designed for use on Negros, Panay, or Cebu probably would have to be transshipped at Manila on an inter-island steamer for the port nearest the point where it is to be installed. Iloilo and Cebu each have some facilities for handling heavy cargo. From either of these points the machinery would probably have to be taken in lorchas or cascoes (native barges or lighters) towed by launch to connect with the land transportation necessary to get it to its destination. The cost of transportation from Manila to the point at which the machinery is to be installed depends, in each case, upon the location of that point and the conditions of local transportation at the time the machinery is received.

The larger sugar factories employ cars with trackage of the same gauge as that of the railroad in order to enable them to send their cars over the line when necessary. These cars carry approximately 20 tons of cane and are equipped with two sets of four wheels each. The factories also use a portable track of a much smaller type for conveying cane to the main lines. This ranges from 28 to 36 inches in width, and the cars carry from one-half to two tons of cane. These cars have but four wheels. Small locomotives are operated over some of these tracks and animal draft is provided for others. The three largest plantations have approximately 25 miles of heavy track and six or eight miles of the light portable track; all of the small centrifugal sugar factories of Negros operate with a light track, and most of them run steam locomotives.

Before the introduction of the modern mill, muscovado and pilon sugar were commonly sold by the planter to the exporters, usually Chinese merchants or European export and import houses, who maintain warehouses in Iloilo, the chief sugar port, for receiving and storing the stocks from the plantations. Sugar produced in Negros was commonly transported to Iloilo on barges towed by launches, while that produced along or near the railroad on Luzon was delivered by cart to cars at the nearest station In the Visayan sugar regions the exporters usually advance money to the planters at certain times against the crops, and the planters are bound to sell their crop to the exporters at prices usually stipulated in advance, and, as a rule, very low. By the use of money made available by the Government, at first through the Bank of the Philippine Islands and later through the Philippine National Bank, the planter gradually ceased to be dependent upon the export merchant and has since been able to sell his output for the best price obtainable in the open market. The use of the modern mill for centrifugal sugar manufacture has brought about a change in the methods of marketing in many localities. It is now very common for the small planter to sell his share of the finished sugar to the central which does his milling. The central in turn frequently exports on its own account. At other times the central, or the larger planter who operates his own mill, sells to export merchants or brokers engaged in buying for foreign houses, and the increasing proportion of the pilon and muscovado sugar is now sold by the small planter to the large mills and centrals for conversion into centrifugal sugar.

On the whole, the Philippine sugar industry is being freed from the handicaps under which it has labored since its inception, and an entirely new life is being infused into it. Some conception of the field yet open in the islands for the installation of modern sugar machinery may be had by remembering that the exports of Philippine sugar are yet well under 300,000 tons per year (by far the greater portion of which is still manufactured by primitive methods), although those best informed concerning the area of land suitable for sugar culture in the islands estimate that the production may easily reach 1,000,000 tons annually.

Trade Notice.

The Kelvin Engineering Co., Inc., engineers and contractors, 32 Broadway, New York, have organized a new department to do general engineering and contracting work in the U.S.A. and in Latin America. This department will be in charge of Carlos Lobo, formerly borough engineer, Department of Water Supply, Gas and Electricity, Borough of Brooklyn, New York. The company will continue its existing business of designing and manufacturing sugar machinery and machinery for various industrial purposes and its export business in machinery of all kinds. In addition, the company is now prepared to execute contracts for furnishing and erecting sugar, electrical and industrial machinery and equipment and for the design and construction of water works. In conjunction with the Nazareth Foundry and Machine Co., Nazareth, Pa., it is equipped to manufacture a variety of castings and to do steel plate and machine work. Gustavo Lobo is president.

Publications Received.

Annual Report for 1917 of the Agricultural Experiment Stations of the Louisiana State University. (Louisiana State University, Baton Rouge, La., U.S.A.) 1919.

It is reported that a number of new seedlings have been secured and planted. Of the older varieties that have been under test for two or more years, L.511 continues to be the most promising, since its first year stubble comes up early, stools well, and grows well. This variety, it is added, should have yielded 56 per cent. more sugar in the factory than the standard varieties now growing, and demands for it are being met as fully as possible. In the Chemical Research Department, of which Dr. F. W. ZERBAN is now in charge, investigations have been carried out on the preparation of decolorizing carbons[1], and the nature of the colouring matter of cane products[2]; while it is stated that a satisfactory method for the determination of sucrose in the presence of reducing sugars "by means of a lead-alkali" has been worked out, the results of which will be published later.

At the request of the owners of several Louisiana sugar-houses, the Mechanical Engineering Department, now under the charge of Mr. A. GUELL, has carried out experiments upon schemes of steam economy, which are stated to have resulted in the saving of hundreds of barrels of fuel oil. A bulletin will later be issued describing this work. Dr. NICHOLAS KOPELOFF is now in charge of the Bacteriological Laboratory, and Dr. MAX SCHNELLER has resigned from the Chemical Department.

Report for 1918 of the Woburn Experimental Station of the Royal Agricultural Society of England. J. Augustus Voelcker, M.A., Ph.D. (Royal Agricultural Society of England, 16, Bedford Sq., London, W.C. 1.) 1919. Price: 1s.

Among the several investigations conducted by Dr. VOELCKER during the period under consideration may be mentioned those dealing with the question of the presence of iron compounds on the fertility of the soil, the crop chosen being wheat. Pot experiments showed that ferrous sulphate, ferrous sulphide, ferric chloride, and ferric sulphide all have singularly little influence upon the growth of the plant. Ferrous chloride, however, was found to have a markedly beneficial effect when not exceeding 0·1 per cent. (as Fe), but if beyond this it produces a decidedly harmful result. Ferric chloride is decidedly toxic, and if present to the extent of 0·2 per cent. is capable entirely of inhibiting growth. Magnetic oxide ($Fe_3\,O_4$) has a slightly stimulating effect.

Scientists' Reference Book and Diary, 1920. (Jas. Woolley, Sons & Co. Ltd., Manchester). 5½ in. × 3¼ in: red cloth. Price, 3s. 6d. net.

Woolley's Scientists' Diary is purchased year by year, by many chemists, and it is hardly necessary for us to introduce this handy little book to our readers. In addition to the pages for the writing of a short diary, it contains reference data arranged in six sections. These relate to such subjects as modern developments in chemistry and physics; chemistry of agriculture; light and heat; thermometry; laws and definitions of chemistry and physics; British and metric weights; atomic and molecular weights; solubility tables; factors for analysis; information concerning indicators; composition of foods; instructions on the rendering of first aid; scientific societies; postal information, etc. It is a useful and practical compilation, and is now in its 22nd year of issue.

(1) **Recomendaciones sobre el Cultivo de la Cana en Puerto Rico.** F. S. Earle. Circular No. 17. (2) **Insecticidas y Fungicidas.** Isidoro A. Colon. Boletin No. 20. (Estacion Experimental Insular, Rio Piedras, P. R.) 1919.

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[1] *La. Bull.*, 167; *I.S.J.*, 1919, 86, 284. [2] *I.S.J.*, 1918, 561; 1919, 180.

Review of Current Technical Literature.[1]

CHANGES IN THE CONSTITUENTS OF CANE JUICE DURING CLARIFICATION AND EVAPORATION.

C. A. Browne. Journal of the American Chemical Society, 1919, 41, No. 9, 1432–1434.

During liming, heating, and subsiding, the suspended impurities removed from the cane during milling (as particles of fibre, peat, wax, chlorophyll, dirt, etc.) are precipitated, proteins and nucleins are coagulated, and part of the gums and mineral constituents are removed. At the same time a new class of degradation and decomposition products enters into solution. By the action of the heat and lime, part of the nucleins are decomposed into nitrogenous bases, or purins, and variable amounts of the reducing sugars are destroyed with the formation of lactic, saccharinic, glucinic, and other acids, while a certain amount of sucrose also undergoes dehydration with the formation of caramel. These changes are illustrated by the following figures, showing the approximate composition of juice and molasses :—

	Juice, per cent.	Molasses, per cent.
Water	83·00	20·0
Sucrose	15·00	30·0
Invert sugar	0·80	30·0
Ash	0·45	8·0
Proteins	0·05	—
Nucleins	0·03	—
Proteoses	0·01	0·10
Nitrogenous bases (guanin, etc.)	trace	0·40
Amides (asparagin, glutamin, etc.)	0·05	0·50
Amino-acids (aspartic, glutamic, etc.)	0·12	1·50
Other organic acids (aconitic, etc.)	0·10	1·50
Gums and pectins	0·10	2·00
Fibre particles	0·12	—
Fat and wax	0·10	—
Earthy matter	0·06	—
Chlorophyll, etc.	0·01	—
Decomposition products (lactic, saccharinic and glucinic[2] acids, caramel, etc.)	—	6·0

In the case of the mineral constituents, the changes that occur are shown by the following table, which has been constructed according to analyses made in Louisiana[3] :—

	Juice, per cent.	Molasses, per cent.
Potassium (K_2O)	45·54	50·83
Sodium (Na_2O)	0·44	0·78
Calcium (CaO)	4·01	7·09
Iron (Fe_2O_3)	0·95	0·32
Aluminium (Al_2O_3)	0·54	0·24
Silica (SiO_2)	6·55	3·91
Phosphates (P_2O_5)	5·72	2·64
Sulphates (SO_3)	21·78	9·91
Carbonates (CO_2)	3·55	11·88
Alkalinity (c.c., N/10 acid to neutralize 1 grm. of ash)	28·0	94·0

These analyses show about 17 per cent. less silica, phosphoric and sulphuric acids, and about 17 per cent. more potash, soda, lime, and carbonic acid in the ash of the molasses; and considered in connexion with the increase in the alkalinity of the ash, show that a part of the basic elements of the mineral salts in the juice enter as the result of clarification into new organic combinations with acid decomposition products, as lactic, saccharinic, and glucinic acids. In the process of evaporation and boiling, the last-named acid undergoes a partial dehydration with the formation of humic acid substances of higher carbon content.

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[1] This Review is copyright, and no part of it may be reproduced without permission.—(Editor, *I.S.J.*)

[2] The term "glucinic" or "glycinic" acid was introduced by PELIGOT to describe one of the unstable acid decomposition products formed by heating "glucose" with alkalis.

[3] *Louisiana Bulletin*, 91 (1907).

Factors governing the Effect of Vegetable Decolorizing Carbons (using "Norit"). *A. B. Bradley. Journal of the Society of Chemical Industry, 1919, 38, No. 22, 396–398 T.*

A study has been made of the extent to which such factors as size of particles, amount of carbon, temperature, concentration of sugar, degree of acidity, etc., influence the quantity of colour adsorbed from solution. "Norit" (washed with water and dried), 60 per cent. liquors prepared from raw Barbados and Mozambique were used, the results of the experiments being as follows:—*Size of particles.*—"Norit" was separated into fractions of increasing size of grain by passing it through sieves having 20 to 124 holes to the inch. It was found that the colour removed increases quite rapidly as the carbon decreases in size of grain until the fractions remaining on the 85 or 95 mesh sieves are reached, but that in the case of fractions of finer particles the increase in the decolorizing efficiency is relatively small. It therefore follows that when one preparation decolorizes better than another it may be due, not entirely to the greater activity of the carbon, but partly to the size of grain. In the case of the largest grains separated (retained on 20 and 30 mesh sieves) the rate of filtration was very slow and the filtrates were muddy owing to the presence of gummy matters that had not been adsorbed. As the size of grain increased, so did the rate of filtration until the fraction passing through the 124 mesh sieve was reached, which seemed to indicate that after a certain limit of fineness the particles pack down so lightly on the filter-paper that a less porous surface is formed. *Percentage of Carbon.*—It was observed that 1·0 per cent. of carbon removed 62·5 per cent.; 2·0 per cent. only 12·9 per cent. more; 3·0 per cent., 7·3; 4·0 per cent., 2·8; 5·0 per cent., 1·7; and 6·0 per cent., 0·8 more This would seem to indicate that the greater proportion of colouring matter in raw sugar liquors is in a crude colloid state of considerable molecular dimensions, and is therefore the more easily removed, whereas the last traces being much nearer a true solution are more difficult to adsorb. Experiments were made in which liquors were treated first, with a small amount of the carbon (say 2·5 per cent.); second, with a very small proportion of a nitrogenous substance (as casein), and boiled; and third with a further quantity of carbon (say another 2·5 per cent.) In all cases the result was found to be better than when the solution was treated with the total amount of carbon (5 per cent in this case) in one boiling without any addition of nitrogenous substance. This seems to indicate that when the less dispersed colloid colouring matters have been removed, the finer or more soluble particles can be agglomerated (probably adsorbed) by added colloids as casein or gelatin and thus removed to a fair extent. *Temperature.*—As far as 70° C., the increasing amount of colour removed for each 10° is rather marked, but between this temperature and boiling point the additional colour is very small. *Duration of Boiling.*—It would appear sufficient to raise the temperature of the liquor and "just boil" (that is, for less than 5 min.), because after 60 minutes the increase in the effect was only 5·3 per cent. *Concentration of Sugar.*—Results were obtained showing that when the concentration of sugar is increased (the amount of colour and other conditions remaining the same) the decolorizing effect decreases quite rapidly as far as a certain point, above which the loss of efficiency is not nearly so marked. Experience teaches the author that when dealing with very dark and impure sugars (as Ilo-Ilo) very much better results are obtained if the syrups are as dilute as possible.[1] *Degree of Acidity.*—Starting with a neutral liquor, tests were made with a number of others each containing increasing quantities of N/10 sulphuric acid, when figures were obtained indicating that the decolorizing efficiency is practically directly proportional (between limits) to the degree of acidity. It was found to make little or no difference whether the acid is sulphuric, hydrochloric, nitric, phosphoric, acetic, tartaric, citric or lactic, excepting perhaps that some were slightly brighter than others, whereas, of course, the rate of hydrolysis of these acids varies very considerably, namely from 100·0 in the case of the first to only 0·4 in that of the last.

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[1] See also Wijnberg, *I.S.J.*, 1915, 70, 129.

PIETSCH CANE FEEDER FOR CANE MILLS. *Anon.* *Facts about Sugar*, 1919, *9*, *No. 11*, *214*.

This apparatus[1] consists of a chute which is supported upon a steel trunnion of a rounded knife-edge design bearing on a special cast-steel trunnion block. The free end of the chute is counter-balanced by a pair of differential levers connected to the chute by two hardened steel links. The differential levers are counter-weighted, and have a series of hand weights which may be used to give any desired tonnage of cane per hour by half-ton increments. The automatic feeder controls the carrier speed, and is governed at all times by the weight of the cane fed to the crusher (and not by the volume, as in the case of manual control), the speed of the cane carrier being automatically increased or decreased, and a uniform feed to crusher and mills ensured. Its advantages are that the extraction of the mill is improved by reason of the uniform quantity of cane fed, due to the even position of the top roll. Stoppages due to chokes are reduced. There is a reduction in the number of hands required in the feeding process. It is now installed in a number of mills in Cuba, and in some it has been in operation for several crops without repair or adjustment.

PRODUCTION OF ACETONE AND ALCOHOL FROM CANE MOLASSES. *John H. Northrop, Lauren H. Ashe, and R. R. Morgan.* *Journal of Industrial and Engineering Chemistry*, 1919, *11*, *No. 8*, *723-727*.

Acetone was one of the substances for which the war created a greatly increased demand. Several processes for its production by fermentation have been described,[2] but in one of the best known of these, that of FERNBACH,[3] in addition to the acetone there is formed about twice as much butyl alcohol, for which there is only a limited demand. Using an organism which has been named *Bacillus acetoethylicum*, and is isolated from old potatoes, a process has been developed by the authors in which by the fermentation of cane molasses both acetone and ethyl alcohol are obtained. In large scale experiments, using a specially designed plant (of which a description is here given), the yield of acetone and ethyl alcohol averaged 9·0 and 22·4 per cent. respectively of the total sugars present.

FACTORS AFFECTING THE HARDNESS OF GUR. *T. S. Swadi.* *Agricultural Journal of India*, 1919, *14*, *III*, *431-439*.

Hardness is an important condition in the successful storage of *gur* during the monsoon in India, and it would seem to depend upon a number of factors. In addition to the glucose ratio (reducing sugars per 100 of sucrose), which may be affected by the ripeness and condtion of the cane, and by the way in which milling, clarification, and boiling are carried out, it would seem from the author's observations that the nature of the salts entering into the composition of the crude sugar has an important influence upon its hardness and keeping quality, due evidently to the hygroscopicity of the salts, the amount of which (solublo in water) may vary from 1·08 to 1·58 per cent. Some samples of *gur* taste sweet, others are distinctly saline; and it is concluded that it is the salts of the soil upon which the cane has been cultivated, and also the water which has been used for irrigation, that must be considered largely responsible. This seems to be borne out by analyses made by the Government Agricultural Chemist, Bombay, who found that two samples of water used in the case of two samples of *gur* contained high quantities of magnesium salts and especially chlorides. A change in the glucose ratio may occur during storage, and this is a point which has yet to be studied by the author.

COMPOSITION OF THE SORGHUM PLANT. *J. J. Willaman, R. M. West, D. O. Spriestersbach, and G. E. Holm.* *Journal of Agricultural Research*, *1919*, *18*, *No. 1*, *1-31*.

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[1] Made by The Fulton Iron Works Co., St. Louis, U.S.A.

[2] U.K. Patent, 14,371; U.S. Patents, 1,691,321; and 1,044,368.

[3] A process similar at least to the original Fernbach process has been developed in England by Dr. WEISSMAN. It has been used successfully in this country and in Canada.

CANE DETERIORATION IN ANTIGUA, B. W. I. *Leo L. Henzell.* *La. Planter, 1919, 62, No. 25, 335.*

It is concluded that the lower sucrose content of the cane milled by the Antigua Central Factory, as compared with that of earlier years,[1] is explained by the following statements:—(1) A considerable amount of unripe cane is ground at the factory, usually at the beginning of the season, it being impossible to take off all the cane in the good reaping months. Three or four weeks longer would remove this difficulty. Different varieties mature much more rapidly than others; and if the planter wished he could arrange to cut such varieties during the first month of the reaping season, giving the others a better opportunity of coming up to the standard. By sending samples to the factory for testing, the result would probably be a gain in weight for him, as well as an increase in sucrose content for the factory. (2) The cane now carries a large amount of tops, roots, and trash; whereas in former days, when muscovado sugar was made, the stalk was well topped and cleaned, in order not to increase the gumminess of the juice and thus affect the quality of the sugar. Now weight is the only consideration. (3) Cane that has been cut for several days and is positively stale, is ground 2 days a week, Monday and Tuesday. Monday at present is a holiday for the field labourers but efforts are being made to abolish this custom. (4) During the past four years, cane from estates upon which a large portion of the crop has been left standing, and has consequently decreased in sucrose content, has been ground. (5) Diseased, burnt, and badly grown cane has been crushed. It is the firm belief of the author that the cane ground by the Central has not actually deteriorated, but that its fall in purity is to be explained by the causes enumerated above. It is intended to remedy these, as far as possible.

MARKED EFFECT OF THE PRODUCTS OF NITROGEN-FIXING BACTERIA AND OF NUCLEIC ACID UPON STIMULATING PLANT GROWTH. *W. B. Bottomley.* *Chemical Trade Journal, 1919, 65, No. 1696, 566.*

It is now claimed by Prof. BOTTOMLEY that he has shown that the products formed by *Azotobacter chroococcum* have a marked effect in increasing the rate of growth of plants of *Lemna minor*[2] in water culture, while the derivatives of nucleic acid (which he has found can be extracted from peat[3]) are also able to act as accessory substances. When added separately to the culture solution these materials increased the number of plants from 1,817 to 96,921 and 80,179 respectively; but when added together the number found was about 293,171, which figure was nearly equal to that obtained with peat, namely, 292,164. *B. radicicola* has an effect similar to that given by *A. chroococcum*, whereas a control test using the ash alone gave no result in respect of rate of multiplication. It is, therefore, concluded that it is these substances that are so essential for the complete metabolism of the plant under consideration, and that normal growth and vigour cannot be maintained for any length of time in their absence.

ON THE USE OF PHOSPHATES FOR THE CLARIFICATION OF CANE JUICES. *Migaku Ishida.* *The Sugar Industry, 1919, 6, No. 6, 25.*

This writer reports that his experiments have shown that on acidifying cane juice by the addition of calcium acid phosphate, a considerable quantity of dissolved lime and pectin remains suspended, from which the conclusion was adduced that alkaline phosphate would be more efficacious. Therefore, a number of different alkaline clarifying agents were prepared with soda and ammonia as the bases, and both juice and molasses were treated with them.

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[1] *I.S.J.*, 1919, 465.

[2] That is, duck weed, which forms a green coating on fresh water ponds and ditches. It is of extremely simple structure; and is the smallest and least differentiated of flowering plants.

[3] *I.S.J.* 1914, 238, 536; 1915, 96, 117, 192, 516, 577; 1916, 222, 233, 357, 472; 1917, 284, 429.

It is stated to have been found that although sodium phosphate is effective it increases the soda content, and also has a tendency to invert sucrose, if the quantity is high. On the other hand, ammonium phosphate is said to have shown a remarkable effect in this direction without causing any increase in the amount of alkalis, while the non-sugars including pectin were eliminated in amount proportional to the increase in the quantity of ammonia in the reagent. Thus di-ammonium phosphate proved more efficient than the mono-ammonium salt.

CROSS POLLINATION OF SUGAR CANE. *H. B. Cowgill. Journal of the Department of Agriculture and Labor of Porto Rico, Vol. III, No. 1, 1919.*

This short paper summarizes the results obtained by the author in crossing sugar canes during the previous four years in Porto Rico. His conclusions are (1) sugar cane can be pollinated from outside pollen and by this process a considerable number of seedlings can be produced ; and (2) characters of the parent varieties are combined in the seedlings by this process. The methods adopted are described in detail, but show no novel characters, being essentially the same as those adopted in Java and elsewhere for many years. The results are summarized for 1915-16, 1916-17, 1917-18, and 1600, 2589, 1794 seedlings were produced in these years respectively. The effect of crossing is judged by the colour of the parents and the seedlings produced and " some other characters." It is, however, rather doubtful if colour is a reliable character, for this has been known to break down completely in selfing many varieties of canes, all manner of colour variations appearing in the resultant lots of seedlings. The author states that he has found it advisable to judge of the inheritance of characters by taking whole groups of seedlings rather than individuals, because of the ever-present chance of selfing in varieties where the pollen was not wholly sterile. COWGILL has noted two varieties which are nearly pollen sterile in Porto Rico. When these varieties were selfed, he never obtained more than five seedlings out of several hundreds of seeds planted, whereas full lots were obtained when the arrows had been crossed with foreign pollen. These observations are on the right lines, but the literature quoted shows that the author is unacquainted with recent work in Java and India, where considerably greater progress has been made during late years. It is hoped to give some details of this work in a future number of this Journal.

NATURE OF THE POLYPHENOL OR TANNIN CAUSING COLOUR CHANGES OF THE JUICE. *F. W. Zerban. Journal of Industrial and Engineering Chemistry, 1919, 11, No. 11, 1034-1036.*

In a previous paper the author has shown that a source of colour in cane juices is the reaction taking place between a polyphenol derived from the cane and the iron salts produced by the action of the vegetable acids on the mill rollers, oxidases also playing a part.[1] He has now investigated the nature of this polyphenol. It is not pyrocatechol, as was proved by digesting sliced cane tops in a bottle with benzene, evaporating the abstract, dissolving the residue in water, when negative tests were obtained, it being impossible to obtain even the iron reaction. In further examining this matter, cane tops were sliced into boiling water, and the extract treated with a slight excess of lead nitrate solution, it having previously been established that the polyphenol is not precipitated by this salt, though normal lead acetate throws it down completely. After treating the filtrate with a normal lead acetate solution, the precipitate obtained was suspended in water, and decomposed with hydrogen sulphide. After filtering, the solution was rapidly concentrated under diminished pressure, and dried finally *in vacuo*. This residue was further purified by extraction with anhydrous ether (in which the polyphenol is almost insoluble), and digested with alcohol (to separate insoluble gummy substances). Finally the alcoholic solution was evaporated to dryness and the residue dried in a vacuum desiccator over sulphuric acid.

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[1] *I.S.J.*, 1918, 561 ; 1919, 180.

This purified polyphenol was then examined more closely. It was found to be soluble in water, alcohol, acetone, and ethyl acetate; but practically insoluble in ether, benzene, and chloroform. It gave a precipitate with gelatin-salt solution, a reaction generally considered characteristic of the tannins and not of the simpler polyphenols (except perhaps gallic acid). Ferric chloride and sodium acetate gave a green colour; and stannous chloride in concentrated hydrochloric acid developed a pink coloration. It responded to Allen's delicate reaction with an ammoniacal solution of potassium ferrocyanide; while its behaviour towards other reagents made it appear that it belong to class Lα in Procter's classification.[1] Heat alone produced pyrocatechol, and no pyrogallol; dilute acids gave rise to phlobaphene and protocatechuic acid, but not ellagic or gallic acids; whilst potash fusion yielded protocatechuic and acetic acids, but no gallic acid or phloroglucinol. It is therefore concluded by the author that the tannin of the sugar cane is a pyrocatechol derivative, closely resembling the oak tannins investigated by TRIMBLE.[2] though not precipitated by STIASNY's reagent, formaldehyde and hydrochloric acid.[3]

BOILING HOUSE DATA, THEIR INADEQUACY. *E. W. Kopke. Sugar News, 1919, 1, No. 2, 17-19.*

An understanding of the attainable standards of efficiency in a sugar factory is exceedingly advantageous; but often these standards are more or less indefinite. In the boiling-house the losses are invariably higher than in the milling department, and there is a greater fluctuation of factors affecting the yield, this tending to obscure the true efficiency of the work. Thus, a boiling-house recovery of 93·0 per cent. may be obtained in a factory not operated as efficiently as another in which this figure[4] does not exceed 88. It is really necessary to take into account the purity of the juice or syrup in considering boiling-house results, or else the results may be presented on a basis eliminating this variable factor. In order more fairly to judge the efficiency of the work, it is suggested that in the well-known formula: $\frac{S\,(J-M)}{J\,(S-M)}$, the actual figures for S and M be substituted, but a constant value for J (as 86·0), this result being termed the "boiling-house recovery ratio." Obviously, this proposed formula[5] would not take into consideration such losses as generally are classed as "undetermined" or those due to filter-press work. It would only account for the sucrose lost in the final molasses, but this is just what one particularly wishes to know about. In a factory operating with one quality only of juice, which does not fluctuate, the results would be much more readily analysed, and the efficiency gauged more reliably; but in the boiling-house one can at least establish a basis for judging the results that will amount practically to the same thing as having a constant quality of syrup. It is of course evident that the factory dealing with very low purities has some disadvantage in the greater quantity of low-grade goods to be handled, and generally in a shorter period; but some of the poorest boiling-house results have been obtained in factories that had very unfavourable conditions, and some of the best results under very adverse circumstances.

ON ANTHOCYANINS. *W. C. de Graaff. Chemisch Weekblad, 1918, 122;* through *Archief voor de Suikerindustrie in Nederlandsch-Indie, 1919, 37, No. 35, 1704-1721.*

A review is given of the literature relating to these important colouring matters, dealing particularly with their occurrence in plants, their localization, their constitution, their differentiation, their formation, and lastly their physiological significance.

J. P. O.

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[1] *Jl. Soc. Chem. Ind.*, 1894, *13*, 487.

[2] "The Tannins," *2*, p. 90.

[3] *Chem. Centr.*, 1908, *2*, 1832.

[4] By boiling-house recovery is meant the sucrose in the commercial sugars per 100 of sucrose in the mixed juice.

[5] J, S and M represent the "apparent" (or gravity) purities of juice, syrup, and molasses respectively.

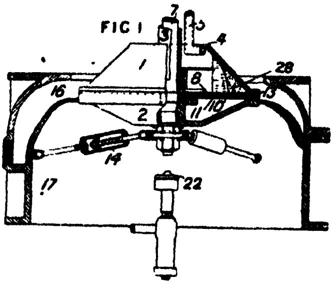
Review of Recent Patents.[1]

UNITED KINGDOM.

CENTRIFUGAL FOR THE CLARIFICATION OF RAW CANE JUICE. *Wilhelm Mauss.* *133,448* (*16,528*). Application date, October 10th, 1918; complete accepted, October 10th, 1919. (Three figures.)

A particular application of this invention is stated to be the treatment of juice coming directly from the mill. It is of the type in which the solids are progressively deposited upon a filter-cloth through which the liquid passes away, the unseparated material being prevented from coming into contact with the filtering surface. As is shown in the drawing, the separating-drum is made up of two conicl members *1*, *2* carried by a hollow shaft *3* and a solid shaft *7* respectively. In the figure the drum is shown in separating position. The material is fed by a pipe *5* to the cone *1* in the direction of rotation and passes down the cone to the filter surface *8*, which is arranged over a grooved plate *10*. Solids *28* are deposited on the conical surface, and the liquid passes away through the filter to the chamber *11* and escapes through the re-curved channel *13* to the receiver *16*. After the separation has proceeded, the material passes over the rim *4* which is of greater diameter than the inner edge of the filter surfaces. Then the supply is stopped, the drum is lowered into the receiver *17*, and the two parts separated, the lower part resting on the support *22*. Lastly, the solids escape from cone *1* and are thrown from the filter. The lower end of the shaft 7 is supported in a bearing carried by spring arms *14*.

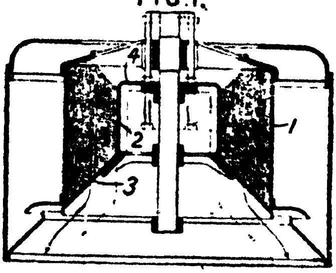
FIC I



CENTRIFUGAL. *Robert Williamson*, of *Pott, Cassels & Williamson*, Motherwell, Lanarkshire, Scotland. *133,195* (*17,673*). Application date, October 29th, 1918; complete accepted, October 9th, 1919. (Two figures.)

Certain materials while being separated in a centrifugal machine from the liquid with which they are mixed do not spread uniformly, but become arranged in a conoidal form, making dehydration unequal, and rendering it difficult to attain full charge of the basket. It has already been proposed to fit within the basket an axially movable structure adapted in one position to close a discharge opening in the lower end of the basket. Such structure has in one case been formed as a dome which in its upper position closed the opening and in lowered position exposed the opening. It has also been proposed to fit within the basket a sleeve slidable on the spindle and having a bottom flange adapted in the lowered position of the sleeve to close a discharge opening in the lower end of the basket. Neither of these proposed constructions answers the objects of this invention.

FIC.I.



Therefore, fitted in the interior of the basket *1* of the centrifugal machine is an axially-movable structure *2* which serves as a lateral boundary for the space within the basket, as a bottom for the basket, and as a discharge valve. It has a vertical or inclined lateral wall, a lower flange *3*, and an upper flange *4*.

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[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sale Branch, 25, Southampton Buildings, Chancery Lane, London, W.C. (price, 6d. each). *United States:* Commissioner of Patents, Washington, D C. (price 5 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 1 fr. 05 c. each).

Conveyors for Moulds used in Chocolate Manufacture. *E. Savy.* *123,988* (*4981* of 1917). Date of application, March 17th, 1917. *Not yet accepted.*

Evaporator, in which the Vapours are Compressed. *P. E. Matter,* of Aarau, Switzerland. 124,732 (*6640*). Date of application, March 17th, 1919; Convention date, March 28th, 1918. *Not yet accepted.*

In a triple effect apparatus, the vapours from all three bodies are compressed and used for heating the second and third bodies.

Evaporator, in which the Vapours are Compressed. *Akt.-Ges. Kummler & Matter,* of Aarau, Switzerland. *123,716* (*17,387*). Date of application, October 24th, 1918; Convention date, February 26th, 1918. *Not yet accepted.*

In an evaporator, the vapour generated by the liquid under concentration is compressed and passed into the heating coil of the apparatus. A portion, however, of this compressed vapour may be led into a perforated coil "to facilitate the generation of vapours."

Evaporator, in which the Vapours are Compressed. *E. Morterud,* of Moss, Norway. *120,882* (*15,962* of 1918). Date of application, October 2nd, 1918. Convention date, November 23rd, 1917. *Not yet accepted.*

In a multiple effect apparatus, the vapours generated in the last evaporator of the series are compressed and used to heat the first body.

Preparation of Decolorizing Carbon from Peat. *John W. Leadbeater.* *132,572* (*13,111*). Application date, August 13th, 1918; complete accepted, September 13th, 1919.

Peat is dried, finely divided, mixed with powdered caustic lime, carbonized and extracted with a suitable acid, as hydrochloric, all as described in a prior specification of the invention.[1] The carbon obtained is mixed with 25-50 per cent. of fuller's earth, kieselguhr, or hydrated aluminium silicate, the addition of which substances has the effect of preventing very fine particles from passing into the filtrate, while also providing a more efficient decolorizer. This preparation gives effective results in treating vegetable oils, the carbon seemingly absorbing one kind of colouring body and the fuller's earth another, so that the combination of the two agents produces a better effect than either singly.

Machine for making Fondant. *Thomas Stevens.* *132,158* (*1831*). Application date, January 24th, 1919; complete accepted, September 11th, 1919. (Three figures.)

Preparation of Sugar for Chocolate Manufacture. *Peek, Frean & Co. Ltd., John Carr, Arthur B Bradley, Joseph Baker & Sons. Ltd., and Rowntree & Co., Ltd.* *132,200* (*9826*). Application date, April 17th, 1919; complete accepted, September 11th, 1919.

According to this invention, a sugar is produced characterized by being in the main composed of rounded, soft and easily crushed grains 0·05 to 0·10 mm. diameter, and containing 2—3 per cent. of moisture and 5-6 per cent. of "glucose." It is prepared by "cooking" a clarified and filtered solution of 55-65° Brix in a steam-heated coil a 254-262° F., and passing the hot concentrated syrup through a "transformer" already described in previous specifications.[2] It is claimed that the use of sugar of this kind made in the manner described improves the quality of the chocolate produced, while effecting economy in the cocoa butter that has to be added to facilitate the grinding and handling of the ingredients.

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[1] *I.S.J.*, 1919, 199.

[2] U.K. Patents 28,296 and 28,297 of 1903, and 4112 of 1904.

FEEDING CHOCOLATE TO WRAPPING MACHINES. *Richard Leumann.* *127,828* (*14,477*). Application date, June 4th, 1919; complete accepted, June 10th, 1919; Convention date, June 7th, 1918. (Five figures.)

BEET HARVESTER. *Julius H. Jacobson.* *124,352* (*11,310*). Application date, July 10th, 1918; complete accepted, March 27th, 1919. (Three figures.)

USE OF BEET FOR MAKING IMITATION PRESERVED FRUIT. *T. Oxley.* *131,797* (*18,924* and *20,664*). Date of application, November 19th, 1918; complete accepted,

Beet is cut into pieces of the size and shape required, and boiled till soft, suitable flavouring and colouring matter and a small quantity of salt and tartaric and citric acid and sugar, if necessary, being added. The whole is bottled, or canned, or it may be sold in the dried state.

EVAPORATION OF THE CLIMBING OR FALLING FILM TYPE. *James A. Reavell and the Kestner Evaporator & Engineering Co. Ltd.* *130,181* (*12,962*). Application date, August 9th, 1918; complete accepted, July 31st, 1919. (One figure.)

In evaporators of the climbing or falling film type, it is essential for efficient and regular working that the liquor should be heated before it enters the tubes. Hitherto, this has been done by means of separate and independent bodies, shells, or calandrias, in which heating tubes are fitted. Now, however, the separate body is eliminated, the heating being performed in the same body as that in which evaporation takes place. In the interior of the evaporator casing, in addition to the usual tubes, one or more tubes through which the liquor passes before entering the evaporator tubes proper, are provided. In this way not only are fluctuations in the working of the apparatus prevented by the impossibility of the entrance of cool liquor, but the cost of construction is reduced, the quantity of piping and the number of fittings being considerably less.

MANUFACTURE OF APPLE JAM. *Clarence H. Simpson.* *123,536* (*3940*). Application date, February 17th, 1919; complete accepted, September 4th, 1919; Convention date (United States), February 15th, 1918.

Apple jam is made by chopping the fruit into pieces with the rind attached, cooking to a half-done condition, adding sugar, and completing the boiling process, terminating this, however, before the cells of the larger particles of the apples break so as to prevent the mass from becoming a pulp. A consistency between a preserve and a paste is thus obtained.

FRANCE.

RECOVERY OF AMMONIA, AMINES, ACIDS, ETC,, FROM CANE AND BEET MOLASSES AND VINASSES. *Lucien Dupont.* *485,597.* Patented January 23rd, 1918.

Almost all the nitrogen present in molasses and vinasses may be recovered by heating with sodium or potassium hydroxide (caustic soda or potash) to 300° C., when ammonia and amines (as trimethylamine) are volatilized, the residue being treated "according to the solubility of the various salts it contains" in order to recover acetates and oxalates.

JAPAN.

PREPARATION OF DECOLORIZING CARBON FROM RICE HULLS, ETC.[1] *U. Tokunga.* *31,604.* Patented, October 8th, 1917.

Rice hulls, fine rice straw, vegetable wax refuse, or potato refuse, are mixed with suitable amounts of magnesium chloride, and charred in a closed oven, the resulting carbon being treated with hydrochloric acid, and washed with water.

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[1] Through *Chem. Abs.*, 1918, **12**, No. 5, 520.

UNITED STATES.

EVAPORATOR, PROVIDING MEANS FOR THE SEPARATION OF CRYSTALS AND THE PREVENTION OF ENTRAINMENT. *William E. Garrigues*, of New Orleans, La., U.S.A. *1,289,925*. Patented, April 1st, 1919. (Three figures).

This invention applies to apparatus for evaporating liquids from which crystalline matter is precipitated during the process of boiling. Its calandria is so constructed that the heating diminishes progressively from the centre to the periphery, this being accomplished by causing the steam to pass successively from the inner to the outer tubes by means of a series of baffle plates. The outer tubes are used as the downcomers, and the separating crystals are swept toward the centre to drop into a collecting vessel beneath. Another feature is that the vapour on the way to the condenser is made to pass into an elevated separating vessel, the bottom of which is connected by a barometric column with a vessel containing liquid.

PROCESS OF MILLING, THE JUICE BEING WITHDRAWN BY SUCTION IMMEDIATELY IT IS EXPRESSED. *Guyon F. Greenwood*, of Quebec, Canada. *1,299,458*. Patented, April 8th, 1919. (Three figures).

Means are provided for "withdrawing the juice direct from the cane at the moment of crushing" In the arrangement described, there is a suction nozzle, preferably of width equal to that of the mill roller. "Its receiving end should lie so close to the stream of cane as to subject the fluid at the moment of crushing to the suction of the nozzle, so that air contained in the stream of fibre will carry with it into the nozzle all of the fluid at the moment when it is set free by the action of the crushing rolls." Claim is made for "apparatus having in combination rolls for expressing the juice from the cane, and means for removing the juice thereby expressed, comprising suction means having its inlet presented in juxtaposition to the surface of one of the rolls immediately below the passing cane."

MIXING DRY LIME WITH LIQUIDS. *James W. Adams and Otto H. Egge*, of Spreckels, Cal., U.S.A. *1,269,994*. Patented, June 18th, 1918. (Two figures)

It is the purpose of this invention to bring a definite quantity of lime in contact with a certain volume of sugar solution (as, for example, in the Steffen process of treating molasses), and to do this in such a manner that the common defects of the formation of unslaked lumps in the liquid, and the deposition of crusts on the walls of the vessel, are avoided, a proper admixture being secured. It consists of a vessel, containing a series of vertical cooling tubes having a central well, and a perforated cover-plate over the upper end of the well. Circulating means for forcing the liquid upward through the tubes, so that it flows over and through the plate, are provided. Further, there is a downwardly projecting casing equipped with a propelling fan, which casing extends into the circulating liquid, upon the surface of which the powdered lime is constantly projected.

JUICE HEATER, UTILIZING BY-PASSED FLUE GASES. *Julius O. Frazier*, of New Orleans, La., U.S.A. *1,311,336*. Patented, July 29th, 1919. (Four figures).

In accordance with this invention, the main flue for the products of combustion flowing to the chimney stack is provided with a by-pass, through which the gases are diverted by means of a damper. Located in the by-pass is a series of connected ducts or pipes presenting a long, tortuous passage for the juice, so that the heated gases may act upon it for a sufficient time. In order to increase the effect, and supplement furnace draft, the by-pass is provided with draft-producing means, such as a fan. The juice is forced through the tortuous passage by any suitable means. Should the flow of juice be stopped for any reason, the course of the flue gases is so controlled that they will pass directly through the flue to the stack instead of through the by-pass, whereby overheating of the juice is avoided. Furthermore, provision is also made for ready access to the pipes through which the juice flows for cleansing. It is claimed that the by-pass very satisfactorily solves the problem of utilizing the waste heat in flue gases, because the installation in no wise interferes with the normal furnace operation. This is due to the fact that the gases may be directed wholly through the unobstructed main flue, or wholly through the by-pass.

PREPARATION OF DECOLORIZING CARBON. *Russell W. Mumford* (Assignor to *Refining Products Corporation*). *1,287,592*. Patented, December 10th, 1918.

Moist comminuted carbonaceous or vegetable matter is mixed with pulverized dolomite to form a plastic material, which is placed in shallow layers in metal trays, and subjected to a gradually increasing temperature rising above 800° C. The carbon thus obtained is quenched in water with exclusion of air, the mineral matter being removed as a sediment, and is dried in a rotating heated tube by means of the gases from the furnace. In a modification, the dolomite is replaced by the product of the reaction of milk-of-lime and mono-calcium phosphate, and the carbon similarly dried by steam.[1]

UNITED KINGDOM APPLICATIONS.

DECOLORIZING AND PURIFYING SUGAR. *D. Grant*. *30,541*. December 6th, 1919.

EVAPORATION. *E. C. Hort*. *30,821*. December 9th, 1919.

BOILING PANS FOR CONFECTIONERY. *R. S. and T. N. McColl*. *30,772*. December 9th, 1919.

DELIVERING MEASURED QUANTITIES OF SUGAR INTO BAGS. *J. W. Crowther*. *31,610*. December 17th, 1919.

PURIFICATION OF LIQUIDS ELECTROLYTICALLY *A. S. Gush* *31,642*. December 17th, 1919.

CENTRIFUGALS. *G Swinden and R. Webster*. *31,724*. December 18th, 1919.

INDICATING DENSITY OF LIQUORS. *C. Butters & Co*. *32,416*. December 24th, 1919.

TINNING SYRUP. *B. M. Jager*. *32,047*. December 22nd, 1919.

EVAPORATOR. *Soc Anon d'Exploitation de Procédés Evaporatoires Système Prache et Bouillon*. *32,140*. December 22nd, 1919.

MANUFACTURE OF CONFECTIONERY. *J. Baker & Sons and C. A. Fankhauser*. *69*. January 2nd, 1920.

UNITED KINGDOM COMPLETE SPECIFICATIONS ACCEPTED.

RECTIFICATION OF ALCOHOL. *E. Barbet et Fils et Cie*. *107,975* (*9659*). October 14th, 1914.

LACTOSE MANUFACTURE. *G. Martin*. (1) *135,614* (*19,692*). November 28th, 1918. (2) *135,969* (*20,836*). December 13th, 1918.

TREATMENT OF RESIDUES CONTAINING CARBOHYDRATES. *J. Effront and A. Boidin*. *122,405* (*131*). January 17th, 1918.

FILTER PRESSES. *R. W. Webster*. *135,976* (*21,057*). December 17th, 1918.

ALCOHOL MANUFACTURE. *Elektrizitatswerk Lonza*. *134,521* (*19,573*). October 27th, 1918.

TRANSPORTING CHOCOLATE MOULDS, ETC. *E. L. A. Savy*. *123,988* (*4981*). March 17th, 1917.

EVAPORATOR. (1) *E. Shaw*. *136,651* (*21,286*). December 19th, 1918. (2) *Soc. Anon. d'Exploitation de Procédés Evaporatoires Système Prache et Bouillon*. *137,052* (*32,140*). December 24th, 1918.

DECOLORIZING VEGETABLE CARBON. *C. E. and S. P. Eastick*. *136,875* (*20,971*). December 16th, 1918.

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[1] See also U.S. Patent, 1,286,187; *I.S.J.*, 1919, 357.

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

	TWELVE MONTHS ENDING DECEMBER 31ST.			
UNREFINED SUGARS.	1916. Tons.	1917. Tons.	1918. Tons.	1919. Tons.
Russia	....	....	....	
Netherlands	....	1,815	7,691	1
Belgium	....	....	....	770
France	....	....	....	8
Java	281,676	270,702	186,193	172,546
Philippine Islands	67,224	6,465	. ..	4,750
Cuba	554,453	699,352	823,901	574,528
Dutch Guiana	2,466	2,518	3,012	1,446
Hayti and San Domingo	4	....	....	....
Mexico	....	....	....	....
Peru	55,613	50,893	41,696	75,808
Brazil	9,196	23,502	8,325	7,239
Mauritius	80,629	31,268	94,416	153,535
British India	47	....	42	5,099
Straits Settlements	....	....	....	....
British West Indies, British Guiana & British Honduras	68,759	129,392	115,914	114,666
Other Countries	2,903	2,131	2,909	19,313
Total Raw Sugars	**1,122,969**	**1,218,039**	**1,284,099**	**1,129,708**
REFINED SUGARS.				
Russia	....	....	....	782
Netherlands	4,276	6,845	6,003	20,799
Belgium	....	....	....	5,903
France	1	1	12	33
Java	94,615	71,841	493	117,906
United States of America	267,048	37,629	5,276	223,747
Argentina	251	2	83	11
Mauritius	27,959	19,854	4,171	24,709
Other Countries	16,238	33,297	5,514	73,869
Total Refined Sugars	**410,389**	**169,470**	**21,551**	**467,759**
Molasses	120,800	139,218	65,597	128,703
Total Imports	**1,654,158**	**1,526,727**	**1,371,247**	**1,726,170**

EXPORTS.

BRITISH REFINED SUGARS.	Tons.	Tons.	Tons.	Tons.
Denmark	1	....	....	....
Netherlands	....	....	....	2
Portugal, Azores, and Madeira	1	....	....	....
Italy	1	....	....	....
Canada	....	1	....	1
Other Countries*	4,472	1,089	804	1,255
	4,475	1,090	804	1,259
FOREIGN & COLONIAL SUGARS.				
Refined and Candy	934	104	933	3,900
Unrefined	3,265	612	208	33,986
Various Mixed in Bond	....	....	....	....
Molasses	851	32	15	9,233
Total Exports	**9,525**	**1,838**	**2,020**	**48,378**

Weights* calculated to the nearest ton.

United States.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1919. Tons.	1918. Tons.
Total Receipts January 1st to December 24th	2,844,054	2,157,611
Receipts of Refined ,, ,,	—	—
Deliveries ,, ,,	2,844,054	2,157,611
Importers' Stocks, December 23rd	—	—
Total Stocks, December 23rd	20,544	11,387
Stocks in Cuba, December 23rd	41,962	139,614
	1918.	1917.
Total Consumption for twelve months	3,495.606	3,683,599

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1916-1917, 1917-1918, AND 1918-1919.

(Tons of 2,240 lbs.)	1916-17 Tons.	1917-18. Tons.	1918-19. Tons.
Exports	2,884,284	2,971,089	3,538,536
Stocks	31,971	273,191	284,152
	2,916,255	3,244,280	3,822,688
Local Consumption	84,400	95,700	82,000
Receipts at Ports to October 31st	3,000,655	3,339,980	3,904,688

Havana, October 31st, 1919 J. GUMA.– L. MEJER.

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR TWELVE MONTHS ENDING DECEMBER 31ST, 1917, 1918, 1919.

	IMPORTS.			EXPORTS (Foreign).		
	1917. Tons.	1918. Tons.	1919. Tons.	1917. Tons.	1918. Tons.	1919. Tons.
Refined	169,470	21,551	467,759	104	993	3,900
Raw	1,218,039	1,284,099	1,129,708	612	208	33,986
Molasses	139,218	65,597	128,703	32	15	9,233
	1,526,727	1,371,247	1,726,170	748	1,216	47,119

	HOME CONSUMPTION.		
	1917. Tons.	1918. Tons.	1919. Tons.
Refined	153,591	43,898	393,806
Refined (in Bond) in the United Kingdom	713,932	739,083	835,756
Raw	231,668	158,230	303,377
Molasses	63,754	36,211	45,937
Molasses, manufactured (in Bond) in United Kingdom	60,172	86,169	72,028
Total	1,223,117	1,063,591	1,650,904
Less Exports of British Refined	1,090	804	1,259
	1,222,027	1,062,787	1,649,645

Sugar Market Report.

Our last Report was dated 6th December, 1919.

The close of 1918 saw the Government in full control of the Sugar Market, and after a temporary period of relaxation during 1919, we enter the New Year under close Government regulation, with every prospect of its protracted continuance.

The various questions arising from the recent Government Order regarding imports of sugar contracted prior to 31st October have been equitably adjusted by the Royal Commission. Such sugars are allowed to be taken by Manufacturers apart from their official allotments and may be dealt in for manufacturing purposes within the maximum price of 115s. per cwt. duty-paid.

The question of continued control in the United States is by no means finally settled by the President's signature to the McNary Bill; because it is not yet known to what extent the powers conferred by that enactment will be exercised. Latest cable advices from New York, however, suggest that the United States Government will refrain from purchasing; a decision which would dispose of any prospect of a buying combination with Europe such as existed over the past two Campaigns, and must entail perpetual competition for cuban sugars. Fortunately the important sales of some 1,500,000 tons already effected by Cuba will go far to satisfy the 1920 demands from miscellaneous quarters, leaving America and the United Kingdom as the principal competitors.

In our last Report we estimated that the Royal Commission would require to purchase some 400,000 tons to complete the needs of the United Kingdom for this year, on the basis of 1,200,000 tons imports; this figure may now be, perhaps, modified since the Food Controller has announced a further reduction in the rations, both for domestic consumption and manufacturing purposes.

Without considering the purchases that have been made of 1920 sugars, it may be interesting to glance broadly at the World's Crops in relation to the demands of Europe, America and the East. To arrive at some approximate conclusion, it is first necessary to consider the Java position. It is estimated that the total stock in that island, as at 1st January, was about 250,000 tons, and it is reasonable to assume that the new Campaign, commencing May/June, will find that quantity practically disposed of. We are therefore left to deal only with the coming crop, which it is believed will not exceed 1,500,000 tons. Deducting 100,000 tons for local consumption and 800,000 tons Eastern exports during June to December, whilst allowing for a stock of 250,000 tons at the end of December, the quantity remaining for export to the West is 400,000 tons. Allowing that the Eastern demands will be satisfied by the shipments from Java (and the quantity which Japan will receive from Formosa), we have to consider only the requirements of Europe and America. The irregularity of harvesting periods renders impossible anything but a rough computation for the actual year January/December 1920; and we have to assume that the crops coming into sight next Autumn will roughly balance the quantities already disposed of ex the corresponding crops of 1919.

Omitting Holland, Italy, and Central Europe as self-supporting, the following table expresses the conclusions we reach:—

Requirements (in thousands of tons)	
United Kingdom	1200
United States of America	4700
France (including exports)	700
Switzerland	110
Levant	150
Norway	80
Spain	40
Canada	350
Sundries	50
	7380

Supplies (in thousands of tons.)	
Java (to the West)	400
Cuba (for export)	4300
Louisiana	115
Porto Rico	425
Hawaii	500
U.S. Beet	700
Philippines (to U.S.A.)	70
Mauritius	200
British West Indies and Demerara	300
San Domingo	180
Peru (for export)	70
Brazil (for export)	30
Argentina (for export)	50
French West Indies and Réunion	100
France (beet crop)	165
Czecho-Slovakia	350
Sundries	50
	8005

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Notes and Comments.

The Sugar Equalization Board.

The McNary Sugar Control Bill empowering the President to continue the United States Equalization Board in office during 1920 was signed by President Wilson at New Year. But the latter evidently came to the conclusion that it was too late to maintain any effective control of sugar or to secure any regular supply at a reasonable price, so official announcement has been made from Washington that the Equalization Board is not after all to continue operations, but that the market is to be left to operate under the usual laws of supply and demand. The new Act, however, maintains the licensing power of the Board as regards domestic producers during the first half of 1920; thereby, any transactions which in popular phrase amount to "profiteering" may result in the discontinuance of producers' or dealers' licences. By this means it is hoped that the interests of the consumer will be maintained against exorbitant prices. Finally, it may be observed, the President still holds the power to put the Equalization Board in control again of sugar transactions, should the occasion arise. But it is not expected that he will readily take this step, if only for the reason that members of the Board themselves, if it is correctly reported, have advised the President that it is better not to intervene further in the sugar situation, but rather to let the sugar market have free play. When the McNary Bill was introduced in the late summer, it was proposed as a means to enable the American Food authorities to purchase the sugar crop of Cuba. But the delays experienced in the passage of the Bill let the opportunity slip, and it is now recognized that there is no longer the control over Cuban sugar that existed a year ago; it is hence unlikely, in the opinion of the U.S. Government, that they could now step in and purchase Cuban sugar, save at an increase in the price to the consumer.

There seems little doubt that the sugar trade in the States will welcome this decision to leave them a free hand within certain limits, for criticism of the Government methods of control has been for some time persistent and unanimous. But from the British point of view, the long series of delays since last August in deciding whether or no the Equalization Board was going to join with the Royal

Commission in acquiring the present Cuban crop have been decidedly unfortunate. Unquestionably, the Royal Commission would have been glad to enter the Cuban market months ago, but they appear to have held their hand in the belief that the American Board would get a fresh lease of life with the same opportunities as last year, and it was obvious that a co-operative deal by the Board and the Commission combined would be the best solution of the problem of getting the needed sugar supplies at a reasonable rate. But obstacles and delays intervened—whether due to the ineptitude of politicians or to strong pressure from the American sugar trade, we prefer not to express an opinion. But we notice that Senator McNARY, representing the consumers' point of view, criticises President WILSON strongly for having refused to purchase sugar last summer "when urged to do so by the Sugar Equalization Board."

The immediate result for us in this country on the facts thus revealed is that the Royal Commission can hardly expect any further co-operation from its former partners in the task of buying Cuban sugar, but will have to act for itself and secure what it can of the balance of the Cuban crop on the best terms available. Unfortunately, the adverse exchange, and the strong demand from the United States for sugar to satisfy the present abnormal American consumption, will not assist matters for us; and one anticipates that what sugar we do secure will only be obtained at a cost that will leave no option but to raise the price in this country still further to the consumer.

Prices in the United Kingdom.

The last rise in retail prices was made in November when Cubes were put up a penny a pound from 7¾d. to 8¾d. (and other sorts *pro rata*). But a further rise has been anticipated for some weeks, and has just lately been semi-officially foreshadowed. It is fully justified by the circumstances, and the only ostensible reason for delaying it further is the inconvenient effect on the uninstructed populace that successive rises in food prices bring in their train.

Meanwhile, the ration has been reduced, from January 19th, from 8 oz. to 6 oz. per head, and the allotments of sugar to catering and other establishments have been curtailed by 25 per cent. The Royal Commission's price for domestic supply remains at 66s. duty paid ex warehouse, but confectioners have now to pay as much as 110s. for their supplies, while free sugars, the maximum price of which is fixed at 120s., have lately changed hands, in the case of White Javas, at 118s. per cwt. duty paid. According to CONNAL & Co. small purchases of Cuban sugars have been made lately at the equivalent of 74s. 8d. per cwt. c.i.f. America for prompt shipment, and at 67s. 10d. c.i.f. for April. At these figures it is obvious that the domestic supply price with us cannot continue indefinitely at 66s., but it will be noticed that the Royal Commission's present policy is seemingly to subsidize the consumer at the expense of the trade sugar users, in order to keep the former contented.

Plantation White Sugar Developments.

For some time past we have held to the opinion that it would not be long ere big sugar producers like Cuba ceased to be satisfied with the rôle of supplying raw sugar to refineries in other countries, and instead took steps to produce in their own sphere of operations white, if not refined, sugar ready for consumption. In our last issue our Cuban correspondent reported that several Cuban factories have already started to turn out their whole output in white sugar, and others a part of their crop. It is expected that the success and the experience gained this season will lead to an extension of the practice. We have ourselves inspected a sample of practically refined cane sugar received in this country from Cuba, the quality of which is above reproach: and we gather that Havana merchants are prepared within the very near future to offer both washed crystals and refined to the world's sugar market. Cuban white sugars have already come to hand in this country: they are described as being of the very best quality, white not yellow tinged, possessing a good sparkle, exceedingly well boiled, and even and regular in the grain. It is clear, then, that Cuban sugar producers have not been slow to realize their opportunities, and that they are evidently bent on putting themselves at an early date in a position of comparative independence of the sugar refiners, especially those of the United States.

Their inclination to go in for the manufacture of direct consumption sugars will be further increased by the report prepared by a special envoy of the Cuban Government, Mr. H. J. DE MESA, on the condition of the European beet sugar industry. This gentleman, who has just returned from an extended tour of the European sugar districts, is firmly convinced that European beet will not be a menace to Cuban cane sugar for a very long time. He is therefore insistent that Cuba should make the most of her present opportunities. He points out that Europe wants white sugar and that therefore Cuba must make it in her factories and cease putting in the pockets of American refiners a huge profit, derived from the Cuban raws which they import, refine, and then re-export to Europe. Mr. DE MESA states that Cuban factories have all the necessary machinery that a refiner requires, save for the addition of bone-black filter installations. To bring a Cuban raw sugar factory to a refining capacity would cost only one-third of what a complete raw refinery would cost. Short of the production of refined sugars, almost any Cuban factory, Mr. DE MESA claims, could be arranged at but little expense to work one of the semi-refined or white sugar processes, thereby turning out a product which would command an increase in price on the world's market greatly in excess of the slight increase in the cost of production.

The temporary elimination of Europe as a sugar producer has resulted in greatly strengthening the position of Cuba as a factor in the world's sugar supply. Of the two biggest cane sugar sources—Java and Cuba—Java has for a considerable time past made herself more or less independent of the refiners. During the war Cuba has been the mainstay of the U.S.A. Atlantic refiners, and to a lesser but still very appreciable extent of the British refiners, since they gladly took all her available 96° raw sugars: submarine dangers during the war and shipping difficulties during the armistice all tended to aid Cuba at the expense of other more distant sources of sugar, Java in particular. But now Cuba is very naturally desirous to eliminate if she can the refining control with its claim on the profits and by turning out finished sugar obtain the means to sell and ship her sugar direct to the consumer. There seems good reason to believe that she is in process of accomplishing this task before many years are out. The high prices the planters have received for their sugar the last few years have provided that one factor which previously they lacked, viz., financial independence, for they now possess, as we must assume, adequate capital to further their plans.

The refiners, it is equally plain, are up against a big problem. In normal times the British houses are not so dependent on Cuba as are their American colleagues on the Atlantic coast; but it cannot be assumed that if Cuba is successful in her new venture the British sources of supply of raw sugar will not attempt to follow her example. The high price of sugar has provided sugar producers generally with just that surplus of capital that they stood in need of to enable them to experiment in new processes, and before long Mauritius may not be the only British colony to turn out chiefly white sugars. The refining interests may indeed be forced in self-protection to act as their own raw sugar producers; it would at all events enable them (in case of necessity) to transfer their interests gradually to the centres of sugar production in the tropics. In other words, if the process of making and refining sugar in one (tropical) factory were some day to vanquish the present dual procedure of making raws near the canefields and refining overseas, the refiners would be forced to shift their spheres of work to the scenes of cane cultivation or else retire from the contest. The last word has not of course been said by them: but no one supposes either that the last process has yet been evolved in the economic manufacture of direct consumption sugars.

New Patent Law in the United Kingdom.

The Patents and Designs Act which became law in December, 1919, makes numerous alterations in British patent law of which the following are among those of most general interest to inventors and patentees. In the first place, the period of provisional protection is increased from six to nine months for all specifications lodged subsequent to March, 1919. The term of the patent is extended from 14 to 16 years, for all patents having applications dated December 23rd, 1905, or later. It is not yet fixed whether fees are to be paid for the 15th and 16th years. A patentee other than a late enemy who has by the war suffered loss or damage including loss of opportunity may now apply in a simpler and cheaper manner than was before possible for the prolongation of the term of his patent. Any person who has acquired, or may acquire by assignment, licence or the like, any interest in a patent or design must now register his interest at the Patent Office. The grounds on which a patent may be opposed are enlarged, and may include the one that the invention has been published in any document published in the United Kingdom prior to the application. Under certain conditions publication of an invention in a paper read before a learned society does not invalidate a patent subsequently applied for; but this is not a provision that should be taken advantage of without professional advice, as it is fraught with great danger.

Another new feature is that a patentee may apply to the Patent Office for his patent to be endorsed "licences of right" in which case he binds himself, in return for a liability to pay only half the usual renewal fees, to give to any person who wishes to use the invention the right to a licence on terms to be settled by the Comptroller in default of agreement between such persons; the Comptroller will be guided in his decision by an endeavour to secure the widest possible user of the invention consistent with the patentee's reasonable rights.

Again it may be noted that hitherto the law has been that if any claim in the specification is held to be bad the action fails, even though the claims in respect of which infringement is alleged are valid; but henceforward the American system of granting relief in respect of valid claims is adopted, the Court having discretion as to costs and the date from which the damages should be reckoned and as to causing the specification to be amended. It is also now provided that where a patent for the original invention is revoked, the Court or the Comptroller may order any patent of addition to become an independent patent. In such cases the duration of the patent is not to exceed the unexpired term of the patent for the original invention.

The new regulations while securing greater justice to patentees in certain circumstances, are also mindful of the interests of the user, and more stringent conditions come into force to prevent the abuse of monopoly rights. It is now enacted that patents are granted not only to encourage invention, but to secure that new inventions shall so far as possible be worked on a commercial scale in the United Kingdom without undue delay; and the Act sets out a number of circumstances under any of which the monopoly rights shall be deemed to have been abused.[1]

Sugar Prices in South Africa and Australia.

As in Australia so in South Africa there has recently been a conflict of opinion politically between the sugar producers and the sugar consumers as to a fair price for that article of food. The increased cost of production of sugar in Natal during 1919 led the planters to revolt against the price of £22 per ton which in February last the Government fixed for the producers. They sent a deputation to Pretoria in October with instructions, if we understand aright, to induce the Government of South Africa to allow them a producer's price of say £35 per ton, and to accord the industry some protection from overseas competition for a period of years. General SMUTS for the Government gave a cordial hearing to the producers' representatives; but it was evident that he had also to consider the demands of the consumer, for in the end the Government would only concede the price of £29 5s. per ton including excise, or £28 5s. net, as the producer's maximum price, but they agreed to a temporary protection of ½d. per lb. (£4 13s. 4d. per ton) on the selling price of imported sugars. The price at which the wholesalers might sell to the retailer was fixed at 31s. 3d. per 100 lbs. while the retailer's maximum to the public was limited to 4½d. per lb. in Durban and 5d. elsewhere.

No over generous sum, it must be said, having regard to the world's price. But even at this moderate figure the consumers in South Africa have been talking in their press about being robbed by the producers. Yet the 5d. per lb. compares very favourably with the 8¾d. per lb. which the British citizen has to pay for his best sugar (even when we allow for 2¾d. being for sugar duty); moreover it is quite on the cards that in a few weeks the price will go up another 1d. or 2d. It certainly would do so now if the public were charged anything like a commensurate price for the sugar the Royal Commission have lately purchased. We believe that South Africa has been blessed so far with a smaller increase in the cost of living than most other parts of the Empire since the war; but prices are on the upward grade even there, and must eventually average themselves with the rest of the world's prices. If that is so, then it is unreasonable to expect the sugar producers of Natal to continue to sell their output at so low a figure as £22 per ton. Mauritius has disposed of her present crop at about £50 per ton.

The Australian consumer would appear to be more unreasonable, for he is reported to be discontented with the very moderate price of 3½d. per lb. for his sugar. We have already had occasion to draw attention to the political controversy existing in that Commonwealth between the consumers and sugar users of the populated southern states, and the sugar producers of Queensland. How long it will persist before an equitable *modus vivendi* is found, it is impossible to say. But it is clear that all over the world there has been far too great a tendency in the past for men earning good wages in their particular trade or calling to expect their food to be supplied them at ultra low prices regardless of the fact that this food has to be produced by the labour of fellow men who are equally entitled to adequate remuneration. It is old history now how in England the agricultural workers in the past have been sweated and their employers half ruined in order that comparatively prosperous labour in the towns might get their food "dirt cheap." This inequality, which has doubtless been paralleled in many another country, is now in process of being altered; but the levelling up means an appreciable addition to the cost of food, and meantime, till the public can be educated to realize the position, they are exceedingly prone to grumble. No one supposes that present prices for sugar are normal (though they are inevitable till the world's shortage has been removed), but it is at all events clear that sugar will never again average the same low price that it did before the war, when we have known sugar to be retailed in the United Kingdom in extreme cases at as low as 1d. per lb., and 2d. to 2½d. per lb. was a general figure.

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[1] For details, patentees will do well to secure a copy of the full provisions of the new Act.

The Cuban Sugar Crop.

Figures issued by the Cuban Producers' Committee give the total production of Cuba for the season 1918-19 as 3,971,776 long tons. Of this amount 2,354,699 tons represents the United States share (being 62 per cent. of the crop), Europe and Canada acquired 1,276,459 tons, direct exports from Cuba amounted to 49,212 tons, and the balance of 136,958 tons represents sugar consumed in Cuba and sugar "not accounted for." The actual amount available for American consumption was however less than the above figure by 154,448 tons, this latter quantity having been re-exported to Canada, South America, and Europe. But as *Facts about Sugar* points out, the net quantity that went into United States consumption was, in terms of refined, equal to a per capita supply of 46·7 lbs. for a population of 105 millions, or enough for the United States requirements for just over 6 months at the weekly rate which prevailed during the first 10 months of 1919. Cuba is thus answerable for half the consumption of the United States in sugar.

The 1919-20 crop is now estimated by Mr. H. A. HIMELY, of Havana, at 31,125,000 bags or 4,446,429 long tons, an increase of 474,653 tons as compared with the previous season. No factory at present is credited with as much as 100,000 tons, but Morón and Delicias are each expected to reach 650,000 bags (93,000 tons), while Cunagua and Stewart will probably make 600,000 bags (85,714 tons). At the beginning of the year it was believed that fully half the crop had already been sold.

International Commission for Uniform Methods of Sugar Analysis.

Arrangements are now being made for the resumption of the work of the International Commission for Uniform Methods of Sugar Analysis, which was interrupted by the war. It will be remembered that the last meeting was held in New York in 1912.

Formerly the Secretary of the Commission was Dr. HERZFELD, of Berlin. It is proposed that the headquarters should be transferred to Amsterdam, under the direction of Dr. H. C. PRINSEN GEERLIGS, thus providing a neutral atmosphere for the discussion of the numerous analytical questions that were postponed, as well as that of others which have arisen during the war.

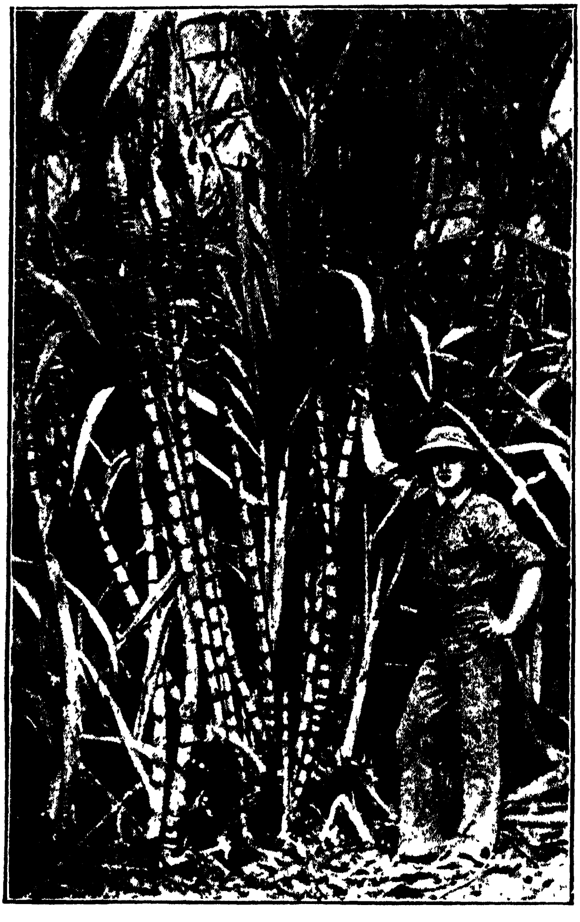
Dr. Geerligs' qualifications as a chemist, the esteem with which he is everywhere regarded, and his linguistic attainments, render him pre-eminently suitable as the future director of the Commission.

This proposal is now under consideration by chemists in different countries.

Agricultural Notes.

Mound of Windrowed Canes in the Punjab, opened two months after being buried. The Canes were perfectly fresh, and there was no sign of rooting or shooting at the joints

The Growth of the Sugar Cane.



A Queensland Crop of Canes showing a sudden change in the length of the joints

Fifty Years Ago.

From the "Sugar Cane," February, 1870.

This issue contained only three articles of technical interest. In the first, which was entitled "Practical Instructions for the Application of the Monosulphite of Lime Process," Dr. E. ICERY, of Mauritius, gave details of his method of preparing calcium sulphite on the plantation. His apparatus consisted largely of a sulphur oven and a vat containing milk-of-lime, which was saturated to an acid reaction to litmus. In applying the process, the juice from the mills, to which previously a small amount of the milky sulphite had been added (to check fermentation), was subjected to the ordinary defecation by lime, and eliminated. After the removal of the scum, 3 per cent. (by volume) of the liquid sulphite was stirred well into the juice, which was then re-heated, and allowed to subside. Lastly, the juice thus treated was concentrated in the triple effect in the usual way. It was contended by Dr. ICERY that contact of the insoluble calcium sulphite with the juice caused a clarifying effect; but it is evident that in his method of preparing this body some bisulphite must have formed at the same time, while during the boiling of the acid juice an evolution of sulphur dioxide effecting a decolorization of the liquid must have taken place.

It is not improbable that when this process was used, or another of the several that were proposed about that time, a greater or less amount of calcium sulphite and sulphate may have entered the syrup, and with the methods of curing then in vogue finally mixed with the sugar. At any rate WILLIAM ARNOT, a refinery chemist, pointed out in this number that the raw sugars passing through his hands contained notable amounts of these salts, ranging from traces to amounts "which might seem to be incredible." He mentioned that it was often the best looking samples that contained these impurities, and that a certain quantity entered into solution in the sugar liquor, causing trouble with the char. During re-burning the sulphates or a portion of them (depending upon the temperature at which this operation was conducted) were decomposed at the expense of the carbon, carbon dioxide being evolved and calcium sulphide formed. He pointed out that the quantity of carbon removed and hydrogen sulphide formed by one complete circle of the refining process might be comparatively trifling, but that it was to be remembered that the same char was often re-burnt and used twice a week. He was of the opinion that from 10 to 20 per cent. of the decolorizing power of char might be destroyed in the course of 12 months by a continued use of sugars containing sulphites and sulphates.

Mention may be made of a paper contributed by Dr. JAMES APJOHN on the "Proximate Analysis of Saccharine Matters." He endeavoured to determine the amount of sucrose in the presence of "inverted sugar" and "grape sugar," by the optical method of ascertaining the rotation before and after inversion, and also by the chemical process of observing the amount of reducing sugars, using Barreswill's solution before and after inversion. The latter method had given results about 2·5 per cent. higher than the other, and it was concluded that this was due to the presence of non-sugar impurities in the product examined. No particulars of the method of clarification, if any, were given.

Lastly, several patent specifications were noticed. W. SPENCE[1] described an improvement in the extraction of juice from the beet by pressing the grated pulp. J. H. JOHNSON[2] claimed a process of extracting juice from cane and beet by maceration with water, to which chemical reagents such as aluminium, magnesium, or calcium sulphite, preferably the latter, had been added. E. T. HUGHES[1] described a process of claying sugar, in which the massecuite contained in moulds was washed by forcing juice through it under a pressure of about three atmospheres. A French patent for a process of clarification in the refinery, the purpose of which was to obviate the use of char, taken out by LAGRANGE and GUILLON[2], was also described. According to this method the raw sugar liquor gauging 30° Bé. was treated with 3 per cent. of its weight of lime, after which sufficient aluminium sulphate to precipitate all the lime was added. It was claimed that after filtering off the aluminium hydroxide and calcium sulphate a well decolorized liquor was obtained, and further that if the quantity of lime was increased to 10 per cent., the syrup resulting was equal to that obtained "by filtering a concentrated syrup made from white sugar over revivified char." In fact, it was stated, the entire elimination of colour could be accomplished in a single operation by this process.

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[1] English Patent, 1915 of 1869.

[2] 1866 of 1869.

The Australian Sugar Industry.

Some Figures of 1918 Production.

The Bureau of the Queensland Sugar Experiment Stations in its nineteenth Annual Report gives the following figures of the production in the 1918 season.

The total acreage under cane in 1918 was estimated by the Government Statistician to be 160,534 acres, a decrease of 15,228 acres compared with the previous year. Of this area cane from 111,572 acres was crushed, leaving a balance of 48,962 acres, which included standover cane, cane cut for plants, and cane planted for 1919. The yield of cane per acre was only 15·01 tons, the previous year (1917) giving a yield of 24·88 tons. The tonnage of sugar per acre in 1918 was 1·70 as against 2·83 in 1917. A figure of much interest is the tons of cane taken to make 1 ton of sugar. This, in 1918, amounted to 8·82, a trifle more than in the previous year, which showed 8·79.

The yield for 1918 only amounted to 189,978 tons of sugar, or 117,736 tons less than were manufactured in the preceding record year of 1917. This yield fell very far short of Australia's consumption, but the surplus for 1917 helped to make up the deficiency. New South Wales produced 19,875 tons of sugar. The yield of sugar from the Beet Factory at Maffra, Victoria, has not been ascertained. The number of sugar plantations is returned as 4148, the average being given as 39 acres to each planter.

The return of molasses shows that in all 7,799,391 gallons were produced.

The price of sugar remained at £21 per ton for raws. This price will continue till the end of the 1919 season by agreement between the Commonwealth and State Governments.

The last few years have seen the closing up of a number of small sugar mills that are unable to continue under present conditions, due to their small capacity and low efficiency. The following mills have gone out of sugar production recently :—Goodwood, Miara, Waterloo, Baffle Creek, and Nerang. The Invicta Mill, which operated near Bundaberg, is now being removed to the Haughton River, in the Lower Burdekin district. It is anticipated that it will be re-erected and ready for the 1920 cane season.

Motor tractors still continue to increase in numbers, particularly in the Northern areas. New types are being introduced, and some of these are doing very good work.

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[1] 1962 of 1869. [2] French Patent, 86,989.

Sugar Cane Work in Porto Rico.

We have recently received the Annual Report of the Insular Experiment Station in Porto Rico for the year 1917 to 1918. The larger portion of this, constituting the report of the Director, E. D. COLÓN, is devoted to a dispassionate review of the work done at the station since its inception until the middle of 1917, and it is further brought up-to-date by the addition of the sectional reports for 1917 to 1918. We propose in the present article to deal with the first part—the record of work from 1910 to the middle of 1917.

During the latter part of the period under Spanish rule, the general position of the sugar planters in Porto Rico was anything but satisfactory.[1] Coffee, which was admitted free into Spain, was the most important crop, while the sugar industry, although reaching in former times a considerable development, led a chequered existence, with a general downward tendency. The economic conditions of the country were extremely bad, and no attempt was made to develop the great resources of the island. Education appeared to have been entirely neglected and communications were in a very backward state. A marked change, however, took place when, in July 1898, the island became part of the United States of America. Coffee lost its advantage of free entry into Spain and suffered a further check from the hurricane of 1899. A forward economic policy was at once introduced, and in a short time sugar became the favoured industry, in that it was allowed to enter free of duty into the United States. The result was that the exports rose steadily, from 62,000 tons in 1901 to 295,000 tons in 1911.[2]

It was at this latter period, according to COLÓN, that the Insular Experiment Station was founded, by sugar producers of Porto Rico, for a scientific study of the sugar cane industry. In 1914 it was presented by this body to the people of the Island, and, although, throughout its existence, the greatest amount of attention was paid to the sugar cane crop, other staples also received some notice. It was placed under the Board of Commissioners of Agriculture (established in 1911), and this body decided to continue the work on the lines laid down by the then Director. In March 1917, lastly, by Act of Congress, the Station became part of the Department of Agriculture and Labor in Porto Rico. Accompanying these changes in administration, there is internal evidence in the report of considerable changes in the personnel of the staff, which are apparently still going on. It would have made the study easier if some details had been given of these changes, as it is sometimes desirable to have a knowledge of the status of the authors of the multitude of papers referred to. A short summary of geographical and economic information on the industry would also have been a boon to outside readers.

PRINSEN GEERLIGS, writing in 1912, spoke of the soil as very fertile, which fact perhaps accounts for his further statement that the sugar cane cultivation was of an extremely elementary character. He also remarked that most of the sugar cane pests and diseases found in other parts of the world were present, but had little attention paid to them. This latter fact has apparently guided the policy of the Station from its start to the present time. In the general review of the work in the six years of its existence, COLÓN deals with the results under different sections. The Entomological work is discussed in 31 pages, that of the Pathologist in 16, while Agronomy and Plant Breeding occupy 12 pages and Chemistry only 6; and this relative amount of space occupied agrees fairly well with the volume of work produced in each section.

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[1] These details are taken from H. C. P. GEERLIGS, "The World's Cane Sugar Industry," 1912.

[2] The present output in Porto Rico is about 400,000 tons.

A perfectly amazing amount of work has already been done on the insect pests found in Porto Rico on the sugar cane, and it is at once evident, on reading the pages devoted to this study, that this could only have been accomplished by a very close association with the fine Entomological Department of the United States Agricultural Department, which has constantly lent its aid in every direction. The aphides, leaf-hoppers and mealy bugs attacking the sugar cane have been collected, studied and named, the mole cricket, weevil stem borer and shot-hole stalk borer have been carefully dealt with; while special sections, showing a vast amount of work, are devoted to the weevil root borer, the moth stalk borer, and, especially, the difficult white grub. A detailed study is accorded to the distribution and life history of these pests in Porto Rico, and the whole is dominated by the careful collection of all possible parasitic enemies of the chief insects attacking the sugar cane. This work is still being continued, but it may not be out of place here to note the present views held by the various workers as to the efficacy of this parasitic and other methods of control. WOLLCOTE sums up the case of the parasites of *Diatraea saccharalis*, the moth borer of the West Indies. In the island itself the grub is attacked by *Cordyceps barberi* and a Tachinid fly of the genus Hypostema, while the eggs are invaded by *Trichogramma minutum*. The abundance of the borer in Demerara varies inversely with the rainfall; the field practice of not burning the cane trash greatly reduces the infestation : cane planted on new land is more heavily infested than on land that was under cane in the previous year: dipping in Bordeaux mixture has no increased effect on germination when the conditions for this are favourable: the amount of dead hearts due to moth borer in young canes does not depend on the kind of seed planted.

The White Grub is probably a much more serious sugar cane pest in Porto Rico, and has accordingly received still greater attention, a special laboratory having been opened for its study at Guanaco. At present ten species of beetles have been isolated as attacking the canes and the life-history of these has been studied. Their cycles, from egg to maturity, vary from three months to one year. Five are species of *Phyllophaga* and have been named fully, all of them being new species; the remaining five are at present not fully studied but all are species of *Dynastinii*. Control methods of every conceivable kind have been tried for white grub, from the introduction of European parasites of the genera attacking white grub there to poisoning the ground and the food plants. These are mentioned in detail, but it is disappointing to learn that none of them have been found to be of practical value, the only way to decrease the attacks at present known being the collection and destruction of the beetles and grubs—"an expensive and not wholly satisfactory method." E. G. SMYTHE, the officer in charge of this work, expresses his doubts as to the accuracy of much of the former work on the parasitism of the various forms of *Phyllophaga* grubs, and states that much has yet to be done in the working out of the life-histories of the various species.

As contrasted with the Entomological work, that on fungus diseases is disappointing. Besides over ninety fungi enumerated "not properly considered as causing disease," and a number of minor diseases of little importance, work has been done on the pine-apple disease, red rot of the stem, rind disease, root disease and yellow stripe. The two last would appear to be far the most serious in the island. The results of the work of the section on these major diseases are, in almost all cases, inconclusive and a number of instances are recorded of schemes laid down for work of which nothing further has been heard. For root disease "planting of resistant varieties" is recommended, "with improved cultivation, liming, drainage, irrigation, burning the trash and other sanitary precautions."

Considering what has been said above about the burning of trash and the moth borer, these general recommendations lose something of their value. With regard to yellow stripe, the 1916-17 campaign closed "with the elimination of the parasitic theory of the disease and its consideration as some form of degeneration." No work on these two important diseases is reported in the appended sectional report of 1917-18.

Considering PRINSEN GEERLIGS' dictum quoted above as to the state of cultivation in the cane fields of Porto Rico, it is disappointing to observe that very little work seems to have been done to improve it by the officers of the section of Agronomy and Plant Breeding at the Insular Experiment Station. A few experiments in manuring were done at the start and manurial plots are, we see, being continued on a small scale, but, during the last few years, almost the whole attention of the section appears to have been devoted to the testing of sugar cane varieties and raising seedling canes. The latter work is being steadily pushed on and will doubtless in time yield results of great importance to the industry, but the work is still in its early stages. With the exception of some papers on the effect of alkali land and salt marsh land on sugar canes, the small Chemical section does not appear to have concerned itself with the sugar industry.

Attention has of late years been drawn in various directions to the necessity of some general agricultural training in offices investigating and combating plant pests and diseases. This would appear to be a truism when we recall that the neglected, half-starved plants in a garden in the tropics soon become the home of all the coccidae of the neighbourhood, just as the weaker members of the herd when turned out to pasture seem to collect all the ticks. Anything tending to lessen vitality or general health will naturally cause a sugar plant to succumb more readily to the diseases and pests around it. Stress of weather, insufficient water supply or drainage, soil that is naturally poor or overcropped, lack of rotation or fallow, insufficiency of humus and the consequent lessening of the numbers of useful bacteria, general lack of good tilth, and a hundred other factors of importance in good cultivation, will naturally occur to those versed in tropical agriculture as likely to render the plants unhealthy. Porto Rico has been shown by the work of the scientific officers to be the happy hunting ground of a very large number of insects and fungi which prey in a more or less active manner on the sugar cane. The intensive scientific study of these is a matter of first importance and this seems to have been very well done. But when the question of control is considered, mere scientific knowledge must be aided by a thorough practical knowledge of the way in which the plant should be grown, and this knowledge cannot be obtained in a new Colony without years of patient work.

The most recent advices from the country speak of a wide-spread outbreak of the baffling mosaic disease, referred to in the Report as yellow stripe. The malady is being fought by a somewhat feverish search for immune varieties, of which *Kavangire* (*Uba ?*) is found to be the most promising. But, when all is said and done, this is a second-class cane, and it would be somewhat of a set-back, in a country with such favourable tropical conditions, if it had to be confessed that it was impossible to grow rich thick canes. In that case, also, much of the careful scientific work done in the past would lose much of its importance. We shall look with interest to see if this search for immune varieties is accompanied by a forward policy in the section of Agronomy along the line of general agricultural improvement.

C.A.B.

The Growth of the Sugar Cane.[1]

By C. A. BARBER, C.I.E., Sc.D., F.L.S.

IV.

The clump or bunch of canes in the field consists of the total output of shoots from one planted set. It is usually made up of several perfectly independent plants, each of which has arisen from a separate bud on the set. The growth of these separate plants, depending on the amount of food and space available, varies a great deal, some being large and dominating the whole clump while others are often small and insignificant, and the canes and shoots belonging to all of them interlace in all directions. We have seen that to make out the branching systems of the distinct plants, a rather tedious process of dissection is necessary, but that, after this has been done, we can construct a formula for each plant. And, when we dissect a number of plants of any one variety, we can obtain an average varietal formula which tends to become simpler and more symmetrical the more dissections are made. We can, in the same way, obtain a formula of each group of cane varieties, and we have seen that these group formula show considerable differences from one another, so that the way in which a cane branches becomes an important character in classification.

In our formulae we have used different letters to indicate branches of different orders. Thus, if we call the main shoot from the original bud on the set a, the branches arising directly from it b, those from b, c, and so on, we can put down the system in algebraical form and our plant formula runs somewhat as follows:— $a + xb + yc + zd + \ldots$ These formulae for the individual plants are of great service for obtaining the averages of the varieties and ultimately of the groups, but we have found that, for the purpose of visualizing the branching in a plant, we must use another method, that of diagrams. In the 767 plants dissected for this piece of work, we have made a diagram of each as it lay on the table, and in these diagrams it has been possible to include many points for which the formulae were unsuited. In the diagram, the intricate interweaving of the branches is supposed to be unravelled and the whole plant laid out in an orderly manner on the table. Such a diagram is given in Figure 3, namely that of a plant of *Saccharum arundinaceum*, a tall, thick-stemmed wild cane of India.[2] It will be seen that in this diagram certain conventions have been introduced which will require explanation, and for their elucidation we have selected another diagram, that of a very strongly-grown *Yuba* plant (Fig. 4) which, it will be remembered, belongs to the Pansahi group of Indian canes. The canes and shoots in this plant were in a veritable tangle, this being caused by the great growth of $b2$, which has developed a number of runners, to be referred to directly. In this diagram the main stem and the branches of different orders are marked by their appropriate letters at their ends, and a different form of line is used for each. The main stem a, is indicated by a thick line, *bs* by thinner lines, *cs* by lines made up of a series of dashes, *ds* by alternate dots and dashes, *es* by dots, *fs* (see Fig. 3) by zigzags. The formulae were, from the first, merely intended to give a statement of the canes at harvest, and only those branches in the diagram have letters attached which would, in our opinion, form canes during the season. But, because of the length of time taken in the dissections (that of the *Yuba* shown took some three days, and the work was spread over several months each year), many of

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[1] The previous articles of this series appeared in our issues of Oct., Nov., and Dec., 1919.

[2] The illustrations to this article have been taken from a paper by the author which was originally published in India; they are here reproduced by kind permission of the Agricultural Adviser to the Government of India.

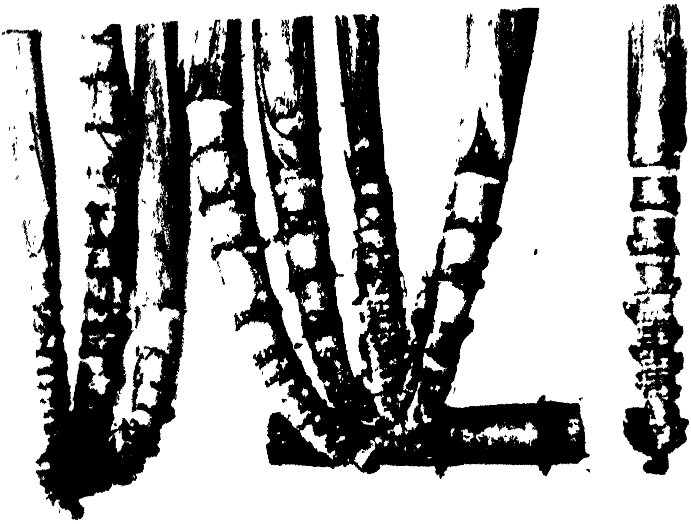


Fig. 1.—Dissection of a "Java" Clump of Canes consisting of three plants (5½ months old).

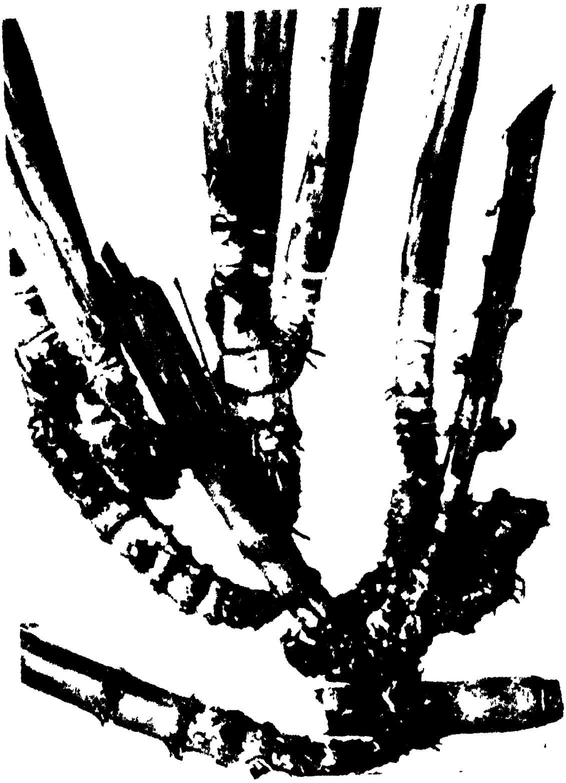


Fig. 2.—Dissection of a "Red Mauritius" Ratoon (20 months old).

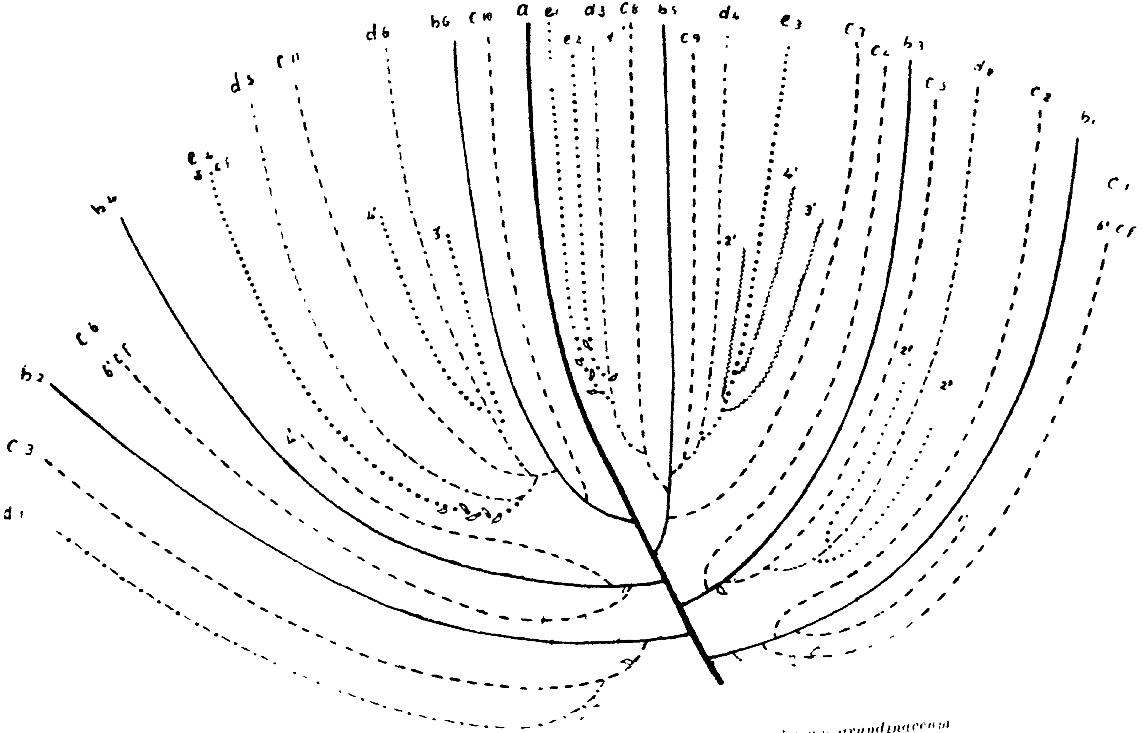
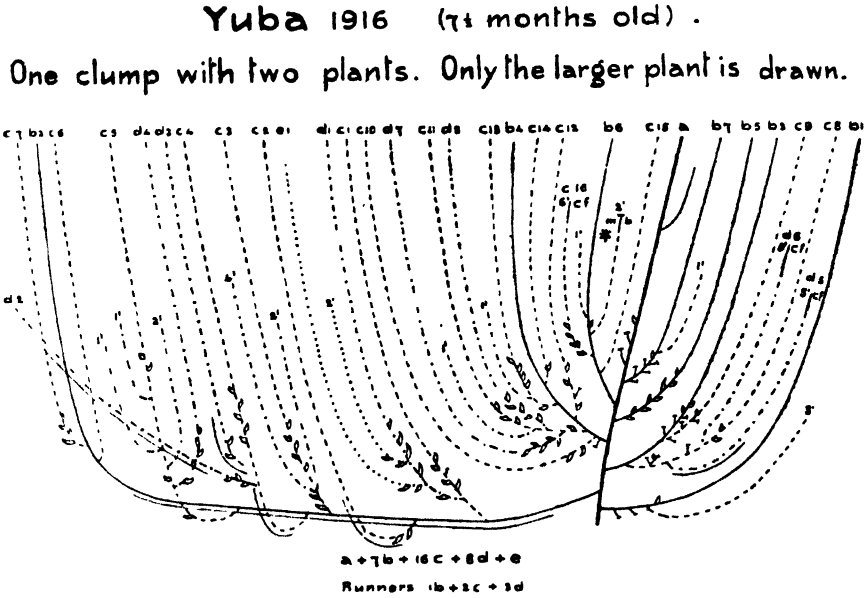


FIG. [illegible] Diagram of the Branching System in a plant of *Saccharum arundinaceum* them had to be dealt with some time before harvest time. This is shown in the diagram. Those branches already forming full-grown canes are brought up to the upper limit of the figure. Of the immature shoots, those which are cane-forming at their base and would have time to mature by crop time are marked *cf* at their ends, and the length of each immature shoot is given in feet. All resting buds are ignored, as taking no part in the growth of the plant, but such as have begun to grow, either by great swelling or actual bursting, are included in the diagram. Cane varieties differ very much in their development of shoots at the base at reaping time, some having practically none while others have a regular sheaf of them, and this character finds its place in the diagram. As is well known, many deaths occur in the dense mass of the bunch, and these have always received careful attention in the dissections. A dead branch is marked by a short cross line at its end, and a similar convention is applied to dead buds, which are shown



Yuba 1916 (7½ months old).

One clump with two plants. Only the larger plant is drawn.

FIG. 4.

as very short lines with a cross line at the end. Lastly, in their struggle to place themselves in a suitable space for unimpeded growth, shoots are capable of altering their position by forming runners underground. These are distinguishable by the intercalation of several long, thin joints between series of very short ones, and occur before the cane commences to increase in thickness. They are marked in the diagram by thin lines placed under the elongating part. Where the cane is attacked by insects an asterisk is inserted, generally with letters indicating the kind of attack. Thus *m.b.* signifies moth-borer, *w.a.* white ants and so forth. All of these conventions are illustrated in the *Yuba* diagram, especially a large number of runners owing to the great effort made by *b*2 in its growth.

On the sheet containing the diagram of any plant dissected various memoranda are written down, some of which are mentioned here and others reserved for the next article. In the *Yuba* plant described we have the following:—

Canes formed, $a + 7b + 15c + 6d + e$
Canes at harvest, $a + 7b + 16c + 8d + e$
Shoots not cane-forming, $b + 3c + 7d + e$
Bursting buds, $b + 13c + 48d + 25e + 4f$
Deaths, $2b + 9c + 7d$
Runners, $b + 2c + 3d$

Considering the great irregularity shown by the plant in its growth, it is somewhat remarkable how nearly the canes at harvest come to a perfectly symmetrical formula. The great number of bursting buds shows how healthy the plant is and this is borne out by the very few deaths in such a large number of buds and shoots in active growth. There are few shoots not cane forming, which seems to indicate that the plant is maturing properly.

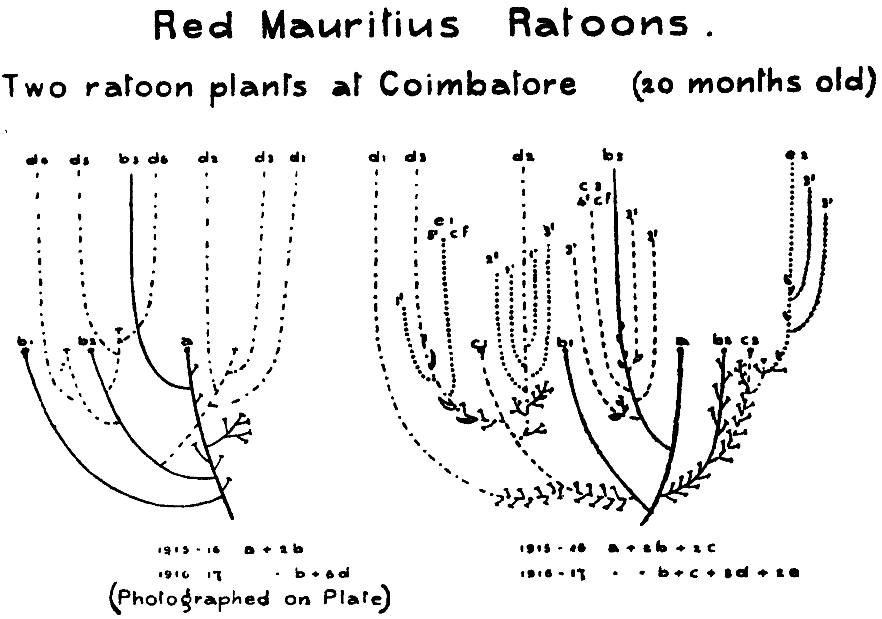


FIG. 5

It was early noted that the members of the Pansahi group of Indian canes were marked by great regularity in their branching systems, and sometimes the way in which the canes grew was distinguished by almost mathematical evenness. Thus many facts of interest in the growth of cane were first noticed in the dissections of members of this group. It would have been impossible to have discovered these facts in the Saretha group, although they were afterwards traced there too, for the Saretha varieties are very irregular and untidy in their habit, crossing and falling about in every direction, showing many deaths and developing many runners. It is somewhat curious that a similar distinction can be drawn between the two cane-forming wild Saccharums of India, *S. arundinaceum* and *S. spontaneum* (the other wild species of this genus do not form solid canes but are seen as great tufts of grass). There are many points of likeness between the formulae of growth of Pansahi and *S. arundinaceum* and there are also marked resemblances between those of Saretha and *S. spontaneum*, suggesting the possibility of genetic connexion between the two pairs respectively. But although this certainly holds with the Saretha-*S. spontaneum* likenesses, all attempts to find additional morphological connexions between Pansahi and *S. arundinaceum* have failed completely. Enough details have, however, been collected to suggest that the Indian canes, at present classed together with the thick canes of the tropics under the species *S. officinarum*, may have arisen from several distinct wild parents (some of which like *S. spontaneum* are still living, whereas others have not persisted in their wild form), while the thick canes may be the descendants of a different though closely allied form.

We have dealt somewhat fully with the branching system of the members of the Pansahi group of cane because they are of special interest at the present moment. This group includes, as we have seen, the *Yuba* cane of Natal and, according to local descriptions, also the *Agaul* recently imported to Natal from India; *Kavangire* also appears to belong, and is considered by some as identical with *Yuba;* perhaps the *Zwinga* and other canes in Brazil may also be included. These are canes inferior in many respects to the thick, juicy, tropical ones, but it is evident that they have their uses, because of their general hardiness in unfavourable conditions, their great tillering power and suitability to the extra-tropical cane-growing regions. It seems likely, from the latest reports, that they will enter more and more into the tropical cane industry, wherever, for some reason or other, thick canes are having a temporary set-back.

In the nature of the case, the thick canes will appear to have received less attention than the groups of Indian canes, but this is because they have been taken together as one group in the dissections. They have by no means been neglected, for as many as 53 plants of various thick canes have been dissected. They present, on the whole, a much simpler form of branching than the Indian groups, and it would be interesting to determine how far the differences noted in this and the next paper may be traced in different varieties of tropical canes. There is little doubt that such differences exist, but no work has at present been done on them in this direction. In Fig. 1 the dissection is shown of the three plants of a rather poorly developed clump of a variety of unknown origin named *Java* in South India. It is in a young stage, but it does not appear likely to produce any more canes at harvest than those shown. In Fig. 2 on the same plate a first ratoon of *Red Mauritius* ready for cutting is shown, and in both cases the original set is still attached to the plant, so that the whole system is displayed, including, in the ratoons, the cut ends of the canes reaped in the first year. Fig. 5 gives the diagram of this ratooned plant, the dots at the ends of the branches signifying canes cut at harvest. There were three canes reaped in the first year and seven are ready for reaping in the ratooned plant. There are no shoots forming, nor are any buds bursting; deaths are few, as only 13 can be counted in the two years. The diagram on the right is also one of a ratooned *Red Mauritius* cane, dissected at the same time and place. It is apparently a much more well developed plant. There were five canes in the first year, but the number of canes in the ratoon crop are seven as in the former case. There are 15 bursting buds, 10 young shoots, and as many as 63 deaths. It would be a matter of great interest if the growth of these two canes could be carried one year farther, as it is to my mind doubtful as to which of the two would produce more canes then, because of the great number of deaths in the bigger plant. One is tempted to compare the two with two runners arriving at the same moment at the winning post. One has used up every ounce of his strength while the other has plenty of spare energy which he has not however made the best use of.

Now a good deal of this rather intricate description of this part of the growth of the cane will, at first sight, appear to be rather of academic than practical interest. In the next article we shall study the characters of the canes of different orders of branching, and we shall see that they not only differ in the rapidity with which they grow and mature, but that the joints differ in length and thickness and in the richness of their juice at harvest time. These are all points of great importance in the crop, especially with regard to determining the best time for cutting the canes.

The Real Situation in the Continental Beet Sugar Industry.

(From a Special Correspondent).

The great changes that have occurred in the economic position of most European countries will undoubtedly have their lasting effect on the areas devoted to beet cultivation, as well as on the class of people who will contract for delivery of beets. In Russia, Poland, Hungary, and in many parts of Germany, the beets were to a very great extent cultivated on large estates, the owners of which in most cases were interested in sugar factories or contracted to deliver their whole beet crop to one sugar factory. The large estates in cultivating the land used every kind of agricultural implement, and by deep tillage and a well-chosen rotation of crops managed not only to reap heavy beet crops, but to raise the yield of cereals and other crops rotated with the beets on the same land.

But as a consequence of the social upheaval in those countries, most of the large estates have now been split up into small holdings, which are occupied by small landowners, who cultivate on their own the portion allotted to them. It is evident that many of them will not want to grow beets, but will cultivate other more directly useful crops instead. Further, they no longer need contract to sell the crop to some special sugar factory, but can as an alternative feed them to the cattle, or else sell them to spirit factories if the roots will fetch better prices there. Finally, the smaller farmers are not so well equipped with implements and do not give the same amount of attention to the results as to know what rotation is most profitable, as did the owners of the large estates with their staffs of overseers and experts; so a smaller return per acre is to be expected. Taking everything into consideration, it is very probable that, until the situation is once more settled in Central and Eastern Europe, the area planted with beets will remain smaller than before the war, while the average yield per acre will also be reduced.

We find in the technical press indications of what has already happened. In Russia the peasants have expelled the landowners and divided up the land into small holdings. In the first days of their new proprietorship, when they found the land already tilled and manured and the crops sown or already growing, life went on smoothly enough; but later on, when the fields had to be prepared for a fresh crop, the lack of ploughs, cattle, manure, and, above all, of security of property, made itself increasingly felt, and farmers preferred a more rapid crop than beets, which have the disadvantage of needing to undergo a special treatment before being turned into the finished product, whereas other crops are not only saleable but also preservable after having been harvested. All these circumstances explain the decrease in the Russian beet sowings that we hear of.

In the *Deutsche Zucker Industrie* has appeared a paper by GRZYBOWSKI on the effect on beet cultivation of the division of land among smaller owners and the result to the crop. It appears that in Poland in 1911 48,750 hectares had been planted with beets by owners of large estates and 28,631 hectares by small farmers. Snce then a great deal of land had come into the hands of small owners; in fact the total area of land in their possession has been doubled. Notwithstanding this fact, the area of land sown with beets in 1919 by small farmers was reduced to 19,502 hectares, while that sown on the remaining big estates showed a decrease to 38,741 hectares. At the same time it was noted that the production of beets to the hectare diminished visibly, as on the small estates only four-fifths of the weight of beets were reaped that was obtained from a hectare of beet land on the large estates with their more rational cultivation and better management.

Similar reports come from Hungary where the large estates have likewise been parcelled out and given to farmers, who will grow other crops than beets, though in former days beets were one of the staple rotation crops. It is, of course, not impossible that later on the farmers may co-operate and start again a rational beet cultivation on a large scale, but, as matters stand now, this division of the land means a reduction of beet sowings.

The price of raw sugar from the new crop (1920-21) will be raised in Germany to 150 marks per 50 kg., in order to allow the sugar manufacturers to pay better prices for the beets than has hitherto been allowed. The price of beets, which previously was by Government orders kept ridiculously low, and much below that of other crops, will in future be left free of control, and it is hoped that this concession will have the effect of increasing the number of hectares planted with sugar beets in Germany, where the area has gone down constantly since 1914. Calculations in German agricultural papers show that, among all crops, beets paid less in the years of the war, owing to the low maximum prices fixed for that product. Even mangels and turnips which require the same labour as sugar beets, but produce a much larger weight to to the hectare, were paid in the free market double the price stipulated by Government for sugar beets. No wonder, then, farmers preferred other crops to beets, and urgent appeals to their patriotism all failed to induce them to sow their former acreage of that crop.

Perhaps the higher price now ruling for sugar and the freeing of sugar beet dealings may cause the German beet cultivation to extend; but there exists yet another impediment which may handicap it. Beet cultivation requires a great amount of manual labour at some particular time. In the large beet-growing districts the population is not numerous enough to supply all of it, and therefore sugar cultivation in Germany has in the past been greatly dependent on foreign labour from Poland and Galicia, which thronged into the German beet districts in summer-time and helped to do all the work connected with beet cultivation and harvesting. Nowadays those foreigners are not forthcoming and so long as they are not available in the numbers known before the war, it will become very difficult to restore the German beet sowings to their former figure, even if the price paid for the beets be no longer an obstacle.

On October 29th M. Jules Hélot, sugar manufacturer, agriculturist, and president of the Chamber of Commerce at Cambrai, presented a Report before the French Academy of Agriculture on the reconstruction of agriculture in the provinces devastated by the war, and came to the conclusion that this process will be a prolonged one. After having given a vivid description of the lamentable condition of those districts and complained of the lack of organization shown by the authorities, he wound up by saying: "Everything shows that notwithstanding the fact that we faced worse things during the past four years, our troubles are by no means at an end. A year ago I told you that the completely ruined landscape from Cambrai to Montdidier and from Albert to St. Quentin and even beyond would require ten years to restore to its pre-war condition and yield the beets needed for our sugar-houses, and even now I stick to that figure." The secretary of that same academy corroborated the words of M. HÉLOT, especially as regards the lack of labour, and from every Department in the north of France complaints are heard of insufficient hands on the farms.

The Secretary of Finance in France, M. KLOTZ, points out the very remarkable change effected in France by the extensive dividing-up of the land among small owners. According to a speech made by him at a banquet of the Association of the Economical and Financial Press, the land comes into the hands of the actual people who till it. Mortgages are being paid back on a large scale throughout France, so that the proprietors become more and more the real owners; further the proletariat gets hold of real estate, the lessees or tenants of the land become the proprietors, and now work for their own account, instead of for that of other people. In short, a great and felicitous change comes over agriculture; the economic and social life is being transformed.

If this be so, and if in the French districts where sugar beets are being grown with profit, the land will henceforth belong to small proprietors, it will be of very great importance if steps can be taken to prevent the same drawbacks ensuing such as we observed in Eastern and Central Europe, where such small proprietors are tending to abandon beet cultivation. An experiment at combining the interests of sugar manufacturers, small growers, and workmen has been started in Bohemia. The *Tageblatt* of Prague mentions that the Moravian Industrial and Agricultural Bank has purchased the two sugar factories of Zborowitz and Kojetein, and is turning the estates in a special joint-stock company, which gives shares in the profits to the beet growers, employees, and workmen. The capital of the new company will be 32 million crowns, while the price to be paid for the two properties amounts to 24 millions. The shares of 500 crowns each are distributed as follows:—(1) 8000 to beet growers under obligation of delivering annually 15 tons of beets per share; (2) 4000 shares to the employees and workmen of the factories; (3) 24,000 shares to the former owners, in part payment of their property; and (4) 28,000 shares for the bank and the public. The shares of groups (1) and (2) receive a preferential dividend of 5 per cent. per annum. This share in the profit for workmen and employees is rather a new feature in the Continental sugar industry, but the participation of the beet-growers in the profit of the sugar factory has of course met with very great success in Holland for 20 years past. According to a recent article by H. C. PRINSEN GEERLIGS, in the *Journal des Fabricants des Sucre*[1], co-operation of beet growers in Holland dates from the year 1900, when a body of farmers, weary of the continual disputes with the sugar manufacturers as to the price and the quality of the beets, the question as to the use of the proper fertilizers and the best seed, established a co-operative society, which built a sugar factory where the beets of the members were worked up and the profits divided among them according to the weight and the sugar content of the beets supplied by everyone. The members are obliged to take out such a number of shares as the management think fit, and to supply yearly a fixed amount of beets per share. Only one-fourth of the value of the shares has to be paid up, and a preferential dividend of 4 per cent. is first paid out of the profits. The necessary money for the building and equipping of the sugar factory is obtained by loans on mortgage, the interest and redemption of which are equally paid for out of the profits before the members receive anything. The beets are carried to the factory and there worked up; the products, sugar, molasses, pulp, and filter scums, are sold just as is done at any ordinary factory.

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[1] December 31st, 1919.

After the expenses, the statutory dividend, the interest and repayment of loans, etc., are deducted from the gross receipts, the net balance is divided among the members, taking into consideration the weight and the sugar content of the beets supplied by them. This money does not constitute a dividend, as the society is a co-operative one, but the net revenue received per ton of beets is considered to be the price fetched by the roots.

The financial results of the first co-operative society were so good that gradually six others were formed, while at the present day the establishment of yet another, the eighth Dutch co-operative sugar factory, is contemplated. In the year 1918, when the Dutch Government distributed the available amount of beets among the sugar factories, the then existing seven co-operative ones were allotted 535,820 tons out of the total of 1,521,440 tons, or about 35 per cent. The price obtained by the members of the co-operative societies for their beets has been considerably higher than that paid by the ordinary sugar factories in the open market, notwithstanding the fact that ample depreciation had been allowed for out of the profits before dividing the balance among the shareholders.

This form of co-operation will be extended in Holland, as the farmers, both large and small, can thus participate, everybody according to his economic ability; but this is not the ideal form of co-operation, which ought to include also the transporters of roots, the workmen, the employees, etc. The great difficulty of allowing those people a share in the profit is that it will not be easy to find a way to make them share too in eventual losses, a contingent liability which is no more than fair, but is rather difficult to enforce in practice.

Agricultural Notes.

Accuracy in sugar cane nomenclature—J.36, Kavangire.—Attention was recently directed in these pages to the increasing necessity of accuracy in the naming of sugar cane varieties, and a case was mentioned, where, in India, considerable confusion had arisen between two very similar Java seedlings, *J.33* and *J.36*, which, besides certain botanical differences, appear to be very differently affected by a local disease. It is curious that confusion appears to have arisen regarding *J.36* in another part of the world. Thus, we read of a cane named *J.56*, which is described in a recent paper by EARLE[1] among the varieties cultivated in Porto Rico. A note at the foot of the page containing this description runs: "Probably an error, as it seems to be the same as *J.36* of the Argentine, which is not the original *J.36* of Java." As the variety here referred to would appear to have been received from Tucumán, it is implied that it is "up to" the latter Station to clear up the mystery, for there would appear to be two cane varieties masquerading under the name *J.36* in South America, and the sooner the matter is cleared up the better.

Yet another case has recently attracted our attention, and it refers to a variety even more prominent at the present moment, the *Kavangire* of South America. This cane is sometimes described as a Japanese form, but we have no information as to this source of origin; it appears improbable that it came from Japan, as that country has no indigenous varieties of sugar cane. Cross,[1] of Tucumán, gives us details concerning this cane in a recent paper. He considers that *Kavangire* and *Uba* are identical varieties. This may well be the case, for Noel Deerr[2] has traced the Natal *Uba* pretty conclusively to Brazil, where the somewhat puzzling name would possibly be derived from *Viba* or *Vuba*, a reed. Cross further states that the *Kavangire* is not the *Cavangerie* of Noel Deerr or the *Cavengire* of Brazil, or, lastly, the *Kavangire* of Santa Barbara. These are presumably thick canes; at any rate this applies to Deerr's *Cavengerie*, which is apparently the cane described by Earle under that name in the work cited above on Porto Rico canes. But, although *Kavangire* and *Uba* may very well be the same cane under different names, Cross is undoubtedly wrong in placing them botanically under *Saccharum spontaneum*. The *Uba* cane is a member of the Pansahi group of indigenous Indian canes, and apparently *Kavangire* belongs there too; and these have very little in common with *Saccharum spontaneum*.

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[1] F. S. EARLE. "Sugar Cane Varieties of Porto Rico," Journal of the Department of Agriculture and Labor, Porto Rico, Vol. III, No. 2. April, 1919.

Here again, then, we have two entirely different canes in the same country assuming the same name, and it is highly satisfactory that Cross should have taken the matter in hand and given us the origin "from Brazil" of the *Kavangire* cane, which, for the moment, is assuming such importance in the Porto Rico sugar cane industry, on account of its disease-resistant properties. He refers to a detailed botanical description of *Kavangire* by Fawcett in a Spanish Journal, and states that this cane is also known on the Tucumán Station as *Sin Nombre 34* and *Bambou de Tabandi*, "and some other (names)." It would be a useful piece of work if Cross would favour us with further notes on the subject, and, at an early date, obtain for us authoritative descriptions of the various canes mentioned in this paper, including, of course, the other "Japanese" cane called *Zwinga*, *Uba* obtained from Natal, and so on.

The matter is of some importance from the point of view of the general history of the migrations of the sugar cane in the far past. When a cultivated plant is known by a number of different names in any country, it generally means that that plant has been under cultivation there for many years. Noel Deerr has suggested that the *Uba* may have been the original cane of the country, introduced by Columbus, and the writer of this note has carried the suggestion one step further, by drawing attention to the canes still growing locally in that part of India which Alexander the Great visited when he first brought this important plant from the East.[3] It would throw a flood of light on the classification of the varieties of the sugar cane if it could be credibly maintained that, after such an immense period of time, so little change had taken place in the botanical characters of a member of the Pansahi group of Indian canes. C.A.B.

The 1919-20 Porto Rican sugar crop is expected by the local Sugar Producers' Association to amount to nearly 478,000 short tons (say 427,000 long tons) as compared with 406,133 short tons in 1918-19. This is an increase of nearly 18 per cent., and is contributed from every section of the island.

Czecho-Slovakian beet sugar factories have been gradually making themselves independent of outside sources for beet seed, having organized some eight years ago a seed company of their own backed by a hundred manufacturers. The enterprise has steadily developed, and this year's crop is expected to yield a surplus, which may be exported. Besides this co-operative seed company, there are two other firms in Bohemia who make a speciality of beet seed production, and these are expected this year to have, likewise, an exportable surplus. Previous to this Czech enterprise, the local sugar industry had to depend mainly on German seed for its sowings.

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[1] W. E. Cross. The "Kavangire Cane," *Louisiana Planter*, Vol. LXIII, No. 25, Dec. 20, 1919.
[2] Noel Deerr. "The Origin of the Uba Cane," *I.S.J.*, XX, 164, April, 1918.
[3] C. A. Barber. "The Origin of the Uba Cane," *I.S.J.*, XX, 406, Sept., 1918.

Progress of the Chemistry of the Carbohydrates during 1918.[1]

By J. C. IRVINE, D.Sc., Ph.D.

CARBOHYDRATES.

During the past year, as has recently being the case, a considerable amount of work has been done on the preparation of various acetylated sugars.[2,3] The methods employed show little or no departure from standard processes, but the work has been directed mainly to the isolation of pure stereochemical forms and to a study of the conditions under which these may be interconverted. In view of the discovery, to which reference was made in a previous Report,[4] that at least four definite galactose penta-acetates exist, research of this description acquires a new importance, and, in addition, the optical rotations of substituted sugars which are thus rendered available are of value in testing generalizations correlating optical rotatory power and constitution in the sugar group.

As is well known, the late J. U. Nef devoted the closing years of his life to an elaborate study of the condition assumed by sugars in alkaline solution, and it is gratifying to find that additional results are now forthcoming[5] in which the work is extended to the cases of *l*-arabinose and *l*-xylose. As was to be expected, these sugars, when oxidized in alkaline solution, give rise to a large variety of oxidation products, and the results not only serve to emphasize the extremely complex nature of a reducing sugar in the alkaline state, but are in agreement with the structural views expressed by Nef in his earlier papers.[6] Nef's ideas also serve to account for the effects which have been observed during the oxidation of maltose in alkaline solution,[7] and, looking back on the publications in which this particular type of sugar oxidation was first discussed, the impression remains that inadequate recognition has been accorded to an extremely fine piece of work. A noteworthy example illustrating the practical application of these ideas is furnished by the successful conversion of rhamnose into methyltetronolactone by the simple process of dissolving the sugar in alkali and passing air through the solution.[8] From the biochemical point of view, the whole question of the oxidation of sugars under mild conditions is important, and signs are not wanting that interest in the subject is being revived.[9]

The interruption of research due to war conditions has delayed the development of systematic work on the specially reactive forms of reducing monosaccharides which are included under the provisional name "γ-sugars," but reference can be made to a paper on the subject which has appeared during the past year.[10] It is now established that in addition to the two crystalline methylgalactosides, a third, non-crystallizable form exists, and it is shown that this variety is analogous in structure to γ-methylglucoside. When completely methylated and the product thereafter hydrolysed, tetramethyl γ-galactose is obtained, and this substance preserves the reactivity which is characteristic of the γ-series. The fact that the methylated sugar undergoes spontaneous auto-condensation on keeping, and is thereby converted into an octamethyl γ-digalactose, is a sufficiently striking example of this reactivity to deserve special mention. As a side issue of the research in question, another interesting result emerges. In his original preparation of methylgalactoside, FISCHER isolated an amorphous product which he regarded at the time as a third variety of the simple galactoside. It now appears, however, that this substance is a methyldigalactoside, and its formation furnishes another example pointing to the idea that the most ready route to the synthesis of di- and poly-saccharides is through the γ-form of reducing hexoses.

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[1] Extracted from the Annual Reports of the Chemical Society, London, for 1918. Compare also previous Reports, *I.S.J* , 1916, 216 ; 1917, 321 ; 1918, 276.

[2] C. S. Hudson and J. K. Dale, *J. Amer, Chem. Soc.*, 1918, **40**, 997.

[3] *Ibid* , 992.

[4] *I.S.J.*, 1917, 321,

[5] J. U. Nef, O. F. Hedenburg, and J. W. E. Glattfeld, *J. Amer. Chem. Soc.*, 1917, **39**, 1638.

[6] *Annual Reports*, 1914, 84.

[7] J. W. E. Glattfeld and M. T. Hanke, *J. Amer. Chem. Soc.*, 1918, **40**, 973.

[8] C. S. Hudson and L. H. Chernoff, *ibid.*, 1005.

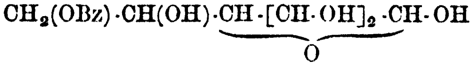
[9] L. Berczeller and E. Szegö, *Biochem. Zeitsch.*, 1917, **84**, 1.

[10] Miss M. Cunningham, *J. Chem. Soc., T.*, 1918, **113**, 596.

Another important step has been gained in the identification of γ-sugars in a structural study[1] of the crystalline variety of methylfructoside recently isolated by HUDSON. This compound is the only known homogeneous methylfructoside, and can thus be converted by standard processes into a tetramethyl fructose which is a definite chemical individual. The compound actually obtained is identical with one of the tetramethyl fructoses previously prepared by PURDIE and PAUL, and, as a result, it is now possible to construct a scheme illustrative of the complex changes which ensue when fructose is treated with acid methyl alcohol. The ketose, like glucose, behaves both as a butylene oxide and as an ethylene oxide, and thus gives rise to at least four fructosides, two of which are derived from γ-fructose. It is significant that fructose should display this ready tendency to react in the γ-form, particularly as it is the same form which is present in sucrose.

At the same time, it must be recognised that although γ-sugars evidently play an important part in natural processes, other variations of the sugar molecule are often functional. Thus, the prediction made by FISCHER some years ago that "glucal" would be found to exist in natural combination is now realised, as the "carbohydrate group" in the nucleic acids has been identified as glucal, and not glucose, as has hitherto been supposed."[2]

So far as synthetic work in the sugar group is concerned, the most outstanding publications of the year deal with the formation of glucose and fructose derivatives in which selected hydroxyl groups are substituted. Details need not be given of the methods employed to limit the substitution to particular positions, as these now present no novel feature, having been standardized in the preparation of partly methylated sugars. The first of the papers[3] refers to the formation of definite mono-, di-, and tetra-benzoyl-glucoses, and of these, the most striking is the monobenzoyl compound, which is apparently identical with the "vaccinin" isolated by GRIEBEL from the whortleberry. The constitution of the new sugar, considering its mode of formation, must be analogous to that of monomethyl glucose,[4] and may thus be regarded as



$$CH_2(OBz)\cdot CH(OH)\cdot\underbrace{CH\cdot[CH\cdot OH]_2\cdot CH}_{O}\cdot OH$$

The dibenzoylglucose prepared does not seem to have been examined in detail, but in all probability it is likewise represented in nature, as a well-defined dibenzoylglucoxylose has been found in the leaves and stems of *Daviesia latifolia*.

Glucosides.—Under this heading only one paper need be considered. In previous Reports, reference has been made to the thioglucosides prepared from glucose ethyl mercaptal by the action of mercuric chloride, and it now appears that this particular reaction is general,[1] giving rise uniformly to α-thioglucosides. The corresponding β-compounds may, however, be obtained by acting on acetobromoglucose with the potassium salts of mercaptans, and the published description of these compounds leads to the opinion that they are true glucosides containing a five-membered ring in which oxygen is replaced by sulphur.

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[1] Miss E. S. STEELE, *J. Chem. Soc.*, *T*, 1918, **113**, 257.
[2] R. FEULGEN, *Zeitsch. physiol. Chem*, 1917, **100**, 241.
[3] E. FISHER and H. NOTH, *Ber.*, 1918, **51**, 321.
[4] J. C. IRVINE and T. P. HOGG, *J. Chem. Soc.*, *T.*, 1914, **105**, 1386.

DISACCHARIDES AND POLYSACCHARIDES.

Although the publications dealing with di- and poly-saccharides are not numerous, several striking important results have to be recorded. Authentic syntheses of disaccharides are few in number, and, excluding those based on the function of enzymes, are characteristic by the use of processes which are drastic and are in no sense parallel to natural synthesis. It is possible, however, to couple reducing hexoses when they are in the form of γ-sugars by comparatively mild agencies to give products which are glucosides of di- and poly-saccharides.[2] To take an example, when galactose or glucose is dissolved in methyl alcohol containing a trace of hydrogen chloride and the solution concentrated, glucoside formation takes place, and simultaneously hexose residues are coupled, so that the ultimate products are respectively methyltetragalactoside and methyltetraglucoside. In this simple way, it is possible to form complexes of high molecular weight, and the ready conversion of maltose into a methyltrimaltoside containing 37 carbon-atoms furnishes a striking case in point.

Interest in thio-derivatives of sugars is reviving, and a new departure is marked in a paper describing the synthesis of a definite thio*iso*trehalose. By the action of potassium sulphide on acetobromoglucose, the octa-acetate of a thiodiglucose was obtained, and this was converted into the parent thiodisaccharide by the action of alcoholic ammonia.[3] The corresponding selenium compound has also been obtained, and as both sugars are crystalline, they have been carefully characterised. It is doubtful, however, if these disaccharides are normal in structure in view of their behaviour on hydrolysis and ready capacity to form monopotassium salts, but this does not detract from the inherent interest of the compounds.

Turning to problems of constitution, the important work described last year on the structure of sucrose has been followed by a similar constitutional study of lactose.[4] The method adopted consisted, as usual, of complete methylation, followed by hydrolysis, and the following scheme illustrates the essential steps :

Lactose → methyl-lactoside → heptamethyl methyl-lactoside
→ Tetramethyl hexose (*A*)
→ Methyl alcohol
→ Trimethyl hexose (*B*)

The work thus focussed on the identification of the two methylated hexoses produced and in the allocation of the methyl groups. The product (*A*) proved to be the butylene oxide form of tetramethyl galactose, whilst the remaining product (*B*) was recognised as trimethyl glucose, identical with that isolated by DENHAM from methylated cellulose. The provisional constitution assigned to this methylated glucose is now confirmed, and in consequence the complete structure of lactose may be represented by the following formula:

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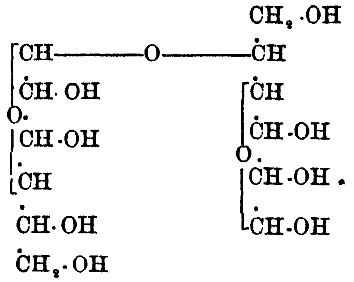
[1] W. SCHNEIDER, J. SEPP, and O. STIEHLER, *Ber.*, 1918, **51**, 220.

[2] Miss M. CUNNINGHAM, *J. Chem. Soc.*, *T.*, 1918, **113**, 604.

[3] F. WREDE, *Biochem. Zeitsch.*, 1917, **83**, 96.

[4] W. N. HAWORTH and Miss G. C. LEITCH, *J. Chem. Soc.*, *T.*, 1918, **113**, 188.



(Galactose residue.) (Glucose residue.

Incidentally, the results have also a direct bearing on the constitution of melibiose, and work of this description goes far to clear up many outstanding problems in the disaccharides. One of the most significant features of the new observations is the experimental evidence pointing to the existence in the case of lactose of what has long been expected, namely, the coupling of hexose residues through secondary alcohol groups. In view of these positive results, it is perhaps superfluous to mention an argument,[1] based on the negative evidence that lactose fails to form an *o*-tolylhydrazone, that the disaccharide is best represented by the unbranched chain structure originally assigned to it by FISCHER.

A Model Sugar Factory Laboratory.

Work in the sugar factory laboratory is mostly of a routine nature, and it is possible largely to standardize operations. Mr. P. V. de VILLELE, chemist at Paauilo, T. H., in a report presented to the Hawaiian Chemists' Association gave the plan of a laboratory so arranged as to permit of the various analyses being carried out with the minimum effort, obviating useless running to and fro as much as possible. The plan is shown in the illustration opposite. The laboratory has two entrances, and three sets of windows; and there is a dark room for polarizing, in which also is arranged a closet for the storage of chemicals and reagents.

There are three departments, and the operations carried out in each are as follows: (1) *Juice department*—cooling, spindling, clarifying and filtering, polarizing, and booking of results. (2) *Bagasse, cane, and fibre department*—chopping, weighing, digesting, drying, weighing digested bagasse, polarizing, weighing dried bagasse, and booking of results. (3) *Syrup, massecuite, sugar, and molasses*—weighing, dissolving (after which the product is passed to the juice department), polarizing by Clerget, and booking of results.

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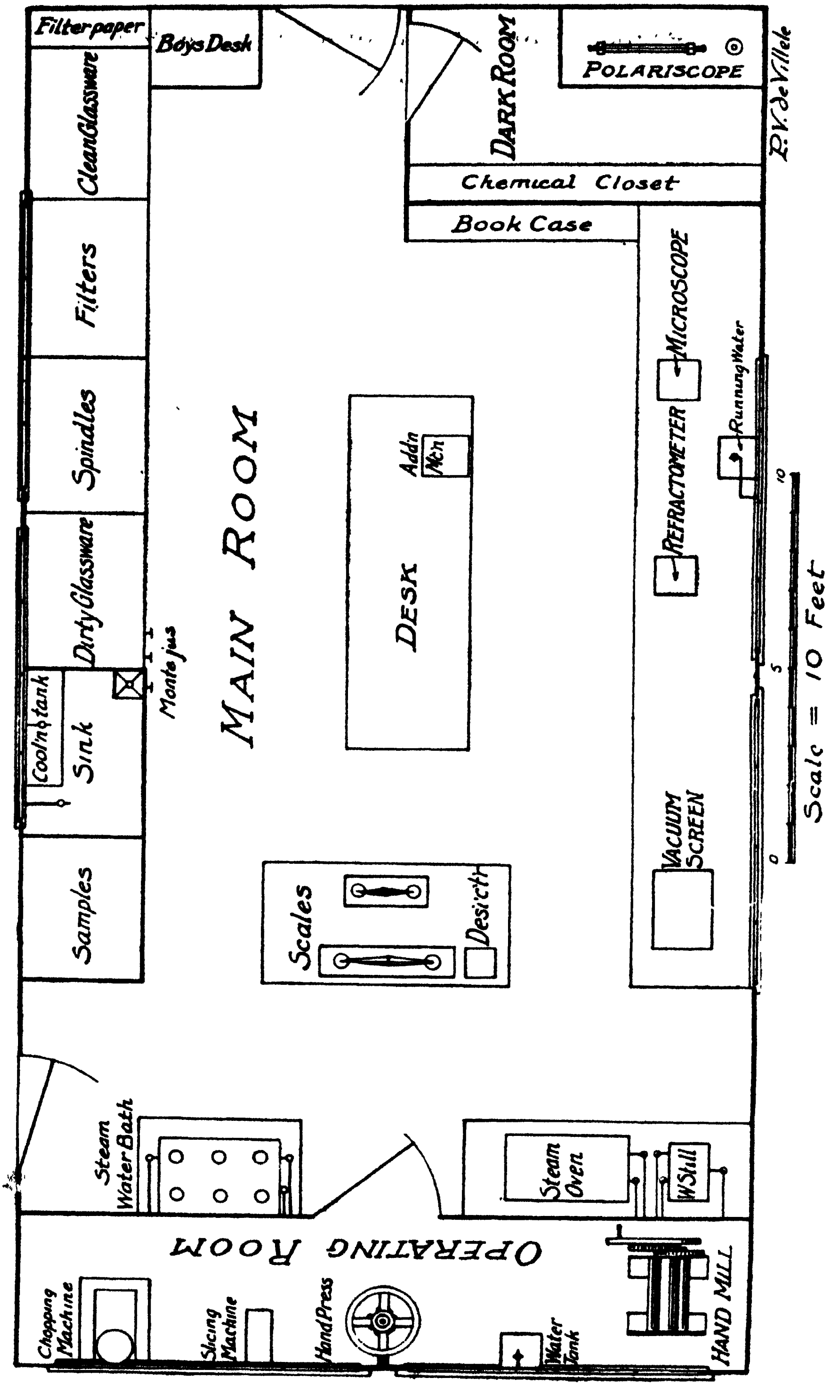
[1] A. W. van der HAAR, *Rec. trav. chim.*, 1918, **37**, 251.



A Model Hawaiian Cane Sugar Laboratory.

Preparation of Decolorizing Carbon.[1]

By F. W. ZERBAN,
Research Chemist, Louisiana Sugar Experiment Station.
With E. C. FREELAND and D. D. SULLIVANT.

PREPARATION FROM ORGANIC MATTER BY IMPREGNATING WITH MINERAL SUBSTANCES.

When the senior author was called upon to investigate this subject further, the effect of different impregnating substances on the decolorizing power of the finished carbon under comparative conditions was studied, always using the sawdust of long leaf yellow pine (*Pinus palustris*). Impregnating substance and sawdust were mixed together with water to a homogeneous paste, and heated in an open vessel over a gas ring till perfectly dry, taking care that the organic matter did not ignite. The dry product was ground, if necessary, and transferred to a receptable made of a 5 in. nipple or 2 in. iron pipe, closed at both ends with iron caps, one of which was not screwed on tightly to permit the escape of gases. The final heating was done by placing the nipple in a muffle furnace at bright red heat, about 900° C., for about 2 hours, though in the case of the more volatile chlorides (as that of zinc) this period was shorter. Lastly, after cooling, the contents of the crucible was extracted with appropriate solvents, as hydrochloric acid or caustic soda, washed with water, and always finally washed with hydrochloric acid, being dried at 105° C.

In order to obtain comparable results, the different impregnating substances were used in chemically equivalent quantities. In the tests with hydroxides and carbonates, or with acids, the basis chosen was 1 part by weight of calcium oxide to 1 of sawdust, the other compounds being taken in amounts corresponding to the quantity of CaO employed. Thus for 1 grm. molecule of CaO, 1 grm. molecule of compounds in bivalent elements, two grm. molecules in the case of monovalent elements, two-thirds in that of trivalent ones, and so forth. With the salts of oxyacids, two series of tests were usually run: one where the salt was used in a quantity equivalent to the basic radicle, and the other where it was equivalent to the acid radicle. In the halide series, the basis was 2 parts by weight of zinc chloride to 1 of sawdust. Therefore, while the different tests in the halide series are strictly comparable with each other, they bear no direct relation to the remaining ones.

The decolorizing effect of the carbons was determined with the use of a solution containing 30 grms. per litre of final molasses as standard (of which a considerable stock was kept); 5 grms. of the carbon were added to 200 c.c. of this 3 per cent. molasses solution, brought just to the boiling point, and passed through a folded filter. "Norit" was used as the standard decolorizing carbon with which all others were compared. After cooling, the solutions were matched in ordinary Nessler cylinders. However, it was soon noticed that sugar solutions contain several different colouring matters in varying proportions, and that the carbons show selective adsorption, the solutions produced by different carbons often differing greatly in tint.[3] The only serviceable apparatus obtainable at the time owing to war conditions was the Hess-Ives tint-photometer, and its use was decided upon, although we were fully aware of its limitations.

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[1] *Louisiana Bulletin*, No. 167 of 1919, A summary of this publication has already been reproduced (*I.S.J.*, 1919, 284-286), and the particulars now given, *en resumé*, are supplementary to that account. [2] *I.S.J.*, 1919, 86-87. [3] *I.S.J.*, 1919, 250.

In the table here given is a list of the sawdust carbons made,[1] arranged according to their power, the "efficiency" of each being expressed in terms of "Norit." Under special conditions of the test, "Norit" removed 81 per cent. of colouring matter. If another removed 96 per cent., it means that the second takes out only 15 per cent. more than "Norit," calculated on the quantity present in the original molasses solution. In using decolorizing agents, however the colouring matter *remaining* in the treated solution is of much greater importance than that *removed* by the carbon; so that the second carbon is not 15 per cent. more efficient, but $\frac{19}{4}$ or 4·75 times more efficient than "Norit," since it leaves only 4 per cent. of colouring matter in the liquor, as compared to the 19 per cent. left by "Norit."

No.	IMPREGNATING SUBSTANCE USED.	Total Colour removed, per cent.	Efficiency, "Norit" being 100.	Ash in Carbon, per cent.
41.	1 mol. sodium carbonate	—	19	18·84
155.	⅓ mol. sulphuric acid	2	19·4	1·87
8.	2 mols. sodium chloride	15	22	2·80
57.	⅓ mol. sodium sulphate	20	24	2·87
61.	⅓ mols. ammonium sulphate	48	37	1·25
50.	⅓ mol. silicon oxide	51	39	24·06
181.	1 mol. calcium metaphosphate	59	46	51·96
31.	1 mol. calcium chloride, plus excess ammonium chloride	60	48	17·66
148.	1 mol. sodium sulphate	63	51	2·13
60.	⅓ mol. calcium sulphate	66	56	3·45
34.	⅔ mol. aluminium chloride, plus excess ammonium chloride	78	86	39·18
161.	1 mol. calcium carbonate	81·5	103	6·75
151.	1 mol calcium sulphate	89	173	3·60
16.	1 mol. stannous chloride	93·5	292	1·37
42.	1 mol. magnesium hydroxide	95·5	422	4·93
40.	1 mol. calcium oxide	95·5	422	12·38
15.	1 mol. zinc chloride	96	475	9·63
20.	1 mol. magnesium chloride, plus excess ammonium chloride	99·4	3200	1·75

It will be noted that in the cases of some of the chlorides which are readily decomposed by water at high temperatures, an excess of ammonium chloride was to be added to avoid such decomposition. While this method works quite well with calcium and magnesium chlorides, it has little effect with aluminium and ferric chlorides. With magnesium chloride, this addition evidently gives very striking results.

A few experiments were made to study the effect of using pure carbohydrates instead of wood when impregnated with equal quantities of lime. The efficiency of paper cellulose, sucrose, dextrose, and starch was 170, 240, 270, and 293 respectively, "Norit" as before being 100. It would appear that the vigour with which lime attacks these substances has something to do with the efficiency of the resulting carbon. Thus, dextrose gives an excellent material; and starch a still better one, probably owing to its fine division.

Effect of nitrogen.—Various investigators have come to the conclusion that the decolorizing effect of animal charcoal (boneblack) is due to complex *C—N* compounds contained in them. It has recently been shown that carbon combines directly with nitrogen at very low temperatures, and it is quite possible that during the preparation nitrogen is taken up, either from the atmosphere or from the ammonium salts added in several of the tests. Sawdust, of course, contains some nitrogen, but the fact that pure sucrose and dextrose impregnated with lime (as just shown) gave very good carbons would speak against the nitrogen theory.

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[1] Altogether 54 carbons are mentioned in the original publication.

In our experiments on the preparation of carbons from kelp,[1] a very much better carbon was obtained than would have been expected in the case of a material consisting practically of organic matter impregnated with potassium chloride. When after the final heating the product was treated with hydrochloric acid, the formation of Prussian blue was often noticed, proving that cyanogen compounds had been formed in the process. An experiment was therefore made in which sawdust was treated with potassium chloride in parallel tests with and without albumen, when efficiencies of 42 and 38 respectively were observed, so that the addition of nitrogen here produced an appreciably higher result. Cotton-seed meal; a material high in nitrogen, but low in ash, gave a carbon of an efficiency of 114, as compared with one of 19 for ordinary sawdust carbon.

PREPARATION FROM PLANT PRODUCTS WITHOUT IMPREGNATION.

A search after cheap raw materials that might be expected to yield carbons effective for production on the large scale was made. Most plant materials contain little ash; but there exists a small number having a high ash content, consisting of infusible material, generally either lime or magnesium salts or silica. Some few plants have the further advantage of being high in nitrogen.

On examining some 18 different materials, results were obtained confirming in a general way those obtained before. Omitting the carbon from Celtis seeds (ash, 37 per cent.), *Macrocystis pyrifera*, the plant with the next highest ash (36 per cent.), gave the best carbon (efficiency, 280); whereas that plant with the lowest ash (0·47 per cent.), *Pinus palustris*, gave the poorest carbon (efficiency, 19). *Sargassum*, a plant high in nitrogen, with the next highest ash (35 per cent.), fairly high in infusible constituents, gave the second best carbon (efficiency, 160). *Chrondrus crispus*, *Ulva*, *Equisetum robustum*, an unknown Mexican fodder plant, *Oryza sativa* (hulls), and *Saccharum officinarum* came next in order with efficiencies of 86, 73, 72, 70, 66, and 63 respectively. Two of the plant materials mentioned were thought to form promising materials for commercial decolorizing carbon production. Rice hulls, the decolorizing power of which was discovered by BLARDONE,[2] yield a carbon having an efficiency from 67 to 145, depending upon the amount of sodium hydroxide used for the elimination of the silicious ash. This carbon has been studied by W. G. TAGGART and M. SCHNELLER,[3] and a patent dedicated to the public has been awarded to the former gentleman.

PREPARATION FROM BY-PRODUCTS AND SIMILAR MATERIALS.

Bagasse as a material for the preparation of carbon was first proposed by M. WEINRICH[4] in 1891, and its purification by means of soda was suggested by W. CLACHER[5] in 1914. It gave a carbon having an ash content of 6·33 (after treatment with caustic soda and hydrochloric acid successively) and an efficiency of only 26. Bagasse might be used instead of sawdust as the raw carbonaceous material in an impregnation process, as for instance, with lime. Beet press-mud was recognised by KARLIK and STANEK[6] in 1903; and cane-press mud by HAZEWINKEL[7] in 1911; while SANDMANN proposed its purification by hydrochloric acid[8]. Our experiments showed that carbon prepared from ordinary defecation cake from Chaparra, Cuba, had an ash content of 21·62 per cent., and an efficiency of 105. Cake from the sulphitation process gave a carbon having values of 52·27 per cent. and 173 respectively. Molasses mixed with kieselguhr and treated with sulphuric acid according to the patent of LYON and PECK[1] gave a carbon having an ash content of 0·52 per cent. and an efficiency of 42; while when carbonization was carried out with gentle heating the values were 1·50 per cent and 52 respectively. This carbon appears very promising, especially on account of its cheapness.

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[1] *I. S. J.*, 1919, 86.

[2] *I.S.J.*, 1919, 90.

[3] *I.S.J.*, 1919, 90.

[4] *I.S.J*, 1917. 406; 1918, 424.

[5] *I.S.J.*, 1914, 64.

[6] *Österr-Ungar. Zeitschrift Zuckerind.*, 1903, 256.

[7] *I.S.J.*, 1911, 274.

[8] *La. Planter*, **60**, 106.

M. WEINRICH[2] impregnates molasses with lime and obtains a hard granular substitute for animal charcoal (boneblack). Samples submitted by him were found greatly superior to char in decolorizing power, and showed efficiencies of 54, 30, and 25. A sample of decolorizing carbon made by his process showed an efficiency of 59, and was therefore superior to the product obtained by the process of LYON and PECK. It would appear, however, that it will be more expensive to produce.

In Porto Rico there exist marshy areas in which the upper stratum consists of a black vegetable mould; while directly below there is a white to yellowish material, which is almost pure carbonate of lime. Two parts of the latter with one of the former material gave a carbon having 40 per cent. of ash and 181 efficiency. Probably the high nitrogen content of the mould is partly responsible for the high decolorizing power of this carbon.

The Mauritius Sugar Industry.

Department of Agriculture Report for 1918.[3]

The total production of sugar in Mauritius for the crop of 1918 is estimated to be approximately 252,370 tons, as compared with 225,370 tons in 1917, 209,030 tons in 1916, 214,520 tons in 1915, and 277,360 tons in 1914. Of the total production of sugar it is estimated that 95·5 per cent. is vesou, 1·4 per cent. first syrups, and 4·1 per cent. low syrups. The proportion of vesou to the total crop shows a further marked increase on the previous year (94·50) and is the highest ever recorded. In 1911 it was 73·80, in 1914 82·01, and in 1917 89·85 per cent. The improvement is due to greater care in the process of manufacture and to the increased demand for sugar of higher grade; in bringing about this result the steadily increasing prevalence of the process of double "turbinage" is largely responsible. Bearing in mind the high proportion of vesou sugar at present being manufactured, the quality may on the whole be regarded as decidedly satisfactory, but there is in some instances still room for improvement in methods of clarification and filtration.

The quality of the canes handled during the crop was on the whole distinctly satisfactory, the saccharine richness being appreciably above the average. Data taken from the *Contrôle Mutuel* Sheets show that as a mean of returns from 32 estates the average composition of the cane handled at the factories was as follows:—Sucrose, 13·63 per cent; fibre, 12·67 per cent. The average extraction of all factories for the crop was estimated to be 10·95, while the average figure for the sugar extracted per cent. sugar in canes according to the *Contrôle Mutuel* figures was 81·1 per cent. The conditions experienced during the reaping season were favourable to the harvest of the canes and practically all the factories had concluded their grinding season before the 31st of December.

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[1] *I.S.J.*, 1918, 431; 1919, 72.

[2] U.S. Patent, 1,308,826; *I.S.J.*, 1919, 625.

[3] Abridged from the Annual Report of the Department of Agriculture, Mauritius, for the year 1918.

During the year 54 factories operated; one factory was dismantled and the canes formerly handled by it were distributed among adjoining estates. Owing to war conditions only minor additions to plant and machinery have been possible. One economizer, two filter-presses, 46 Weston centrifugals, two dynamos, five suction gas engines, and some 24 malaxeurs had been installed by the commencement of 1918.

At the same date the total area under cane cultivation was estimated to be 168,356 arpents, an increase of 806 arpents[1] over the similar figure at the commencement of the preceding year. Of this total, 92,538 arpents were cultivated by Estates and 75,828 arpents by planters, estate cultivation representing 55 per cent. of the total cultivated area. The total area under cultivation by Indian proprietors or lessees amounted to 72,633 arpents or 43·1 per cent. of the total area.

There are practically no improvements in relation to agricultural operations to be recorded during the year. This is in part to be attributed to war conditions which have to a large extent precluded the importation of agricultural implements. Some interest has been excited on the question of the possibility of the introduction of agricultural tractors, but no practical steps have been possible up to the present.

Pests and diseases of sugar canes have attracted a good deal of attention during the year. Root disease has become more prominent in many localities and considerable areas are recorded as having been somewhat seriously attacked. In many such cases the advice of the Department of Agriculture has been sought and appropriate treatment given. It should be emphasized that the control of this disease is largely a question of agricultural methods employed. In the District of Pamplemousses the control of *Phylalus Smithi* has been the subject of a considerable amount of activity. Early in the year, in a report presented to the Colonial Government and to the Board of Agriculture, the Director of Agriculture emphasized that the most serious factor of the situation was the gradual extension of the infected area by slow outward spread. The matter was further considered at a special meeting of planters held at Pamplemousses in October, 1918, and, with the co-operation of planters, measures were taken for the patrolling of the periphery of the infected area by special gangs with a view to controlling the outward spread of the pest. In relation to the establishment of *Tiphia parallela*, the parasitic enemy of *Phylalus Smithi*, evidence accumulated during the year indicates that the insect has established itself satisfactorily at many points in the infected area and is already exercising a perceptible effect in controlling the pest. In 1917 the attempt was made to introduce into Mauritius *Scolia oryctophaga* as a parasite of the "Gros Moutouc," *Oryctes tarandus*, which is responsible for considerable damage to cane fields in the island. Evidence obtained during the year points to the parasite having satisfactorily established itself in Mauritius, and there seem to be reasonable grounds for expectation that satisfactory results may ultimately be secured as the result of this introduction.

Interest has continued to centre in the question of new and improved varieties of cane owing to fears which were expressed in some quarters that the White Tanna variety may be degenerating. The question has received the careful consideration of the Department of Agriculture and a definite system of co-operative experiments with new varieties of canes has been laid out on a number of estates in different parts of the Colony. It is well to emphasize that agricultural conditions in Mauritius demand a cane which is capable of being ratooned for relatively long periods, and, as Professor J. B. Harrison, C.M.G., Director of Agriculture in British Guiana, has recently indicated, the breeding of varieties possessing these characteristics is very much more difficult than the production of new seedling canes which are capable of giving satisfactory returns as plant cane or as plants and first ratoons. With the exception of Mauritius and British Guiana, there are practically no cane countries where intensive methods of cultivation are practised in which long ratooning is the rule, and consequently new varieties produced in other parts of the world are generally selected on account of their capacity to yield satisfactory crops of plant canes, their ratooning power being to a large extent ignored. Consequently, the chances of securing satisfactory canes possessed of considerable ratooning power from countries outside Mauritius are naturally minimized. On the other hand, the fact that cane varieties do eventually tend to degenerate renders essential that the work of raising and trying out new varieties of canes should be rigorously prosecuted, since this affords the only means at present available of replacing cane varieties in the event of their ceasing to become serviceable.

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[1] The arpent is practically one acre.

The year 1918 will long be remarkable for the conditions governing the disposal of the sugar crop. Early in July, 1918, the Secretary of State for the Colonies intimated by cable to His Excellency the Governor that the Royal Commission on the Sugar Supply would be willing to buy *vesou* (white first product) sugar for export to the United Kingdom, but that in view of shipping difficulties the total of such offer could not exceed 50,000 tons. At the same time it was stated that the embargo on the export of sugar would be raised so soon as arrangements had been made to ensure the provision of adequate funds in India for the purchase of essential supplies during the ensuing twelve months. With reference to the price at which the sugar so taken was to be purchased, it was, at a later date (July 23rd, 1918), intimated that the offer made would be based on the average of prices paid by the Royal Commission during the past four years, 17s. 6d. being offered as the middle price, with variations of 4d. up and down for superior and inferior grades, prices in all cases to include 2d. shipping commission. This offer was accepted by the planters of the Colony. The work of apportioning the amount of the Royal Commission purchase among planters and other holders of sugar was delegated by the Government to the Department of Agriculture, the Statistician of the Department, Mr. H. ROBERT, being placed in charge of this operation. It was subsequently (September 6th) intimated by the Secretary of State that in the event of the Royal Commission finding itself in a position to purchase additional quantities of *vesou* sugar, the price paid would be the same as for the first 50,000 tons.

In view of the possibility that grave difficulties might be encountered in disposing of the remainder of the *vesou* crop, owing to lack of freight, and in order to secure uniform treatment for all, while relieving the anxieties of planters, and stabilizing the main industry of the Colony, the Secretary of State for the Colonies in August, 1918, authorized the Governor to submit the following proposal to the Chamber of Agriculture:—

"That the Government should take over the whole of the *vesou* sugar of the 1918-1919 crop, not already contracted for, and should sell it on behalf of the planters, on the following terms:—The Government would pay Rs. 7·50 per cwt. for all sugar ready for delivery. The sugar would then become the property of the Government, and would be sold by the Government to the best advantage. All profit obtained, after payment of expenses for storage, interest, etc., would be distributed to planters in dividends as soon as it would be safe to do so."

This offer was accepted by the Chamber of Agriculture on behalf of the planters, and, as legislation was necessary to carry it into effect, a Special

Ordinance (No. 8, of 1918) was passed. To enable the operations under the Ordinance to be carried out, the Secretary of State made arrangements with the Government of the Federated Malay States, whereby a sum of £1,750,000 was placed at the disposal of the Crown Agents, bearing interest at the rate of 5½ per cent. per annum. Under the terms of the Ordinance, a Committee was appointed by the Governor to advise in connexion with the sale of sugar; this Committee consisted of 14 members, comprising leading planters and brokers and one or two officials, under the Chairmanship of the senior Puisne Judge of the Colony. In addition, a Grading Committee of two members and a Board of Arbitrators of three members were also appointed. They divided the sugar into three grades, viz., *a*—fine to finest, *b*—good to fine, *c*—medium to good.

The scheme worked most satisfactorily, the disposal of the crop proceeding much more favourably than had been at first anticipated: by the commencement of November nearly half the crop (including the 50,000 tons purchased by the Royal Commission) had been disposed of. With the signature of the Armistice, matters further improved, freight became much easier, offers at enhanced prices were received, while the Royal Commission offered to purchase all unsold stocks at a price 1s. per cwt. higher than their original offer, i.e., 18s. 8d. per cwt. f.o.b. By December 20th practically the whole crop had been disposed of. The average sale price for the entire crop was 17s. 10d., while actual prices ranged between 17s. 2d. and 20s. It was found that only £1,200,000 were required as advances from the Federated Malay States, and by March 31st, 1919, this sum and the interest thereon had been entirely paid off. By the end of 1918, 99,771 tons of sugar had been shipped; of this amount 48,148 tons were destined for the United Kingdom, 46,096 tons for India, and the remainder to other destinations.

Difficulties in relation to transport of cane and sugar by the Government railways were experienced in an enhanced degree during the year, owing to the impossibility of obtaining adequate supplies for the maintenance of engines and rolling stock.

Difficulties also continued to be experienced in obtaining supplies of artificial manures for canes; potash salts have been practically unobtainable, while other manures have only been available at very high prices. Limited supplies of sulphate of ammonia have by arrangement with the Secretary of State for the Colonies, continued to be available throughout the year; the price quoted has been Rs. 650 per ton. It may once again be emphasized that an economic limit exists to the profitable nature of applications of artificial manures to canes, and that a point may occur when the cost of manurial applications exceeds the value of the resulting increase in yield; it is in consequence important to ascertain clearly the relationship between the cost of application of artificial manures and the value of the resulting increment.

At the end of the year the condition and the immediate outlook of the sugar industry of the Colony appeared to be distinctly favourable. The advent of the armistice and the consequent relaxation in relation to Government freight requirements greatly ameliorated a situation which at the commencement of the crop gave rise to grave forebodings. The ultimate outlook for the industry is more problematical since, owing to its geographical position, the Colony is disadvantageously placed in regard to access to the majority of the world's markets. Now that facilities are likely to become available for the introduction of improved machinery and for the amelioration of methods of cultivation, it is hoped that full advantage will be taken of opportunities for the re-investment of capital with a view to effecting greater economies in production and manufacture.

Agricultural Machinery and Implements in Hawaii.

The Report of the Committee on Agricultural Machinery and Implements of the Hawaiian Sugar Planters' Association for the year ending September 30th, 1919, has little that is new or of interest. Mr. LIDGATE, the Chairman of the Committee, as the result of his customary enquiries of plantation managers, concludes that the tractor has become a very considerable factor in the motive power of the sugar plantations and will replace animal power to a still greater extent as they become more familiar with their use. But he judges that it is on flat level lands that tractors will do their best work, since experience with the Yuba tractor (a creeping track type of 20-35 H.P.) shows that on steep hillsides their efficiency is very much less than on fields which do not average over 8 or 10 per cent. grades, while on the steeper fields the delays from stops and repairs are much more frequent; again in the case of a light tractor such as the Fordson (with ordinary spudded driving wheels) it may succeed on flat dry lands for light work, but in hill climbing in Hawaii its capacity is so much reduced or absorbed that the effective power is limited to the load which three mules could haul.

As regards cultivators, Mr. LIDGATE records that they find the John Deere 14-tooth duck-footed harrow very efficient for cultivating in young plant cane, as it disturbs the weeds and stirs the soil without throwing much dirt into the cane row.

Answers from plantation managers to enquiries show that the principal tractors used are 45 H.P. Holt Caterpillars, 45 H.P. Bests, Clevelands (which are found to save a lot of mule labour in light cultivation and ploughing in small awkward and inaccessible places where the large tractors could not go), and the 20-35 H.P. Yubas. All four types above cited are of the creeping track type.

Mr. DAVID FORBES, the Manager of the Waiakea Mill Co., wrote: "As a general change in methods of motive power is rapidly taking place, the writer believes that a greater number of tractors has been added to the equipment of Island plantations during the past year than in any similar space of time. There are few plantations now which do not have one or more tractors to replace mules in the heavier cultivation of soil. With the high cost of animal food, as well as expensive labour to handle those animals, it is no doubt found to be more economical to use tractors where practicable. The tractor does not get tired, and will work overtime at the same rate of fuel consumption. This is of great consideration, for when weather and other conditions are favourable it means much to have the land prepared for planting at the proper time. It is the writer's belief that at no distant date tractors will be on the market of a lighter build, adapted to such work as cultivation of cane rows and destruction of weeds, or in fact any sort of work where a mule, or mules, can now be used for cane cultivation. It takes no great stretch of imagination to look forward to such machinery and implements of agriculture being used more extensively, and propelled by home-made fuel produced from our waste molasses. On Waiakea Plantation for many years gas engines have been used for the loading of cane on to our railroad cars, with very great success.

"Were it not for the extremely rough and rocky nature of our lands I doubt that not much of our cultivation would be carried out by tractors; but as such land runs up breakages and upkeep to such a point, it remains doubtful if tractors can be used with economy and efficiency to replace the mule."

Mr. JAS. GIBB, the Manager of the Honolulu Plantation Company, wrote: "On this plantation we have two Yuba tractors and a Cleveland. With the Yuba we plough, harrow and do almost all our furrowing. They can pull two ordinary furrow ploughs without any trouble. We use them also for hauling cane cars on portable track, and hauling cane from the upper land with wagons modelled after the Paauhau cane wagon. They can turn in much less space than a five-mule team, and haul cane on very rugged land. We usually hook on two or three wagons at a time. In the fall of the year we off-bar with the Yubas, hauling two 14-in. or three 10-in. ploughs. This can be done without much damage to the cane if the tractor is carefully driven. We have had these two Yuba tractors now for over two years and cannot speak too highly of them as useful machines for plantation work. The Cleveland tractor we have had only four or five months. All of this time it has been kept steady off-barring ratoons with a set of right and left 10-in. ploughs. We figure that this small tractor is doing the work of eight or ten mules at ploughing between ratoons."

The Possibility of applying the Diffusion Process to Shredded Cane.[1]

By A. FRIES.

The high state of efficiency in a modern milling plant is in some way due to the fact that methods have been adopted which approach those of the diffusion process, the disintegrating of the cane before crushing and the more liberal application of maceration water being instances. Together with improvements in the rollers, such modifications have made possible a recovery of sugar in the mixed juice not equalled by diffusion.

Naturally all these changes extended over a period of many years. They brought along difficulties in the boiling-house and fire-room equipment similar to those of diffusion, but these were also gradully met and overcome. It is therefore reasonable to suppose that if diffusion were installed at the present time it could profitably take advantage of some of the improvements made, thereby overcoming some of the serious problems that presented themselves in former years.

Col. Z. S. SPALDING, who first introduced diffusion in the Islands, and whose plant operated very successfully for many years at Kealia, Kauai, says: "Diffusion was given up on account of the inability to dry the exhausted cane chips enough to burn in the furnace of that time without extra and expensive fuel. To-day our furnaces would burn them freely and economically."

Equally interested and prominent in the enterprise of 30 years ago was Mr. J. N. S. WILLIAMS, whose concise and clear conception of the proposition as it presents itself to-day is of special value and interest. He says:

"Diffusion at the present day is a very different proposition to what it was 30 years ago. The large single battery built at that time was to treat 400 tons of cane per day (24 hours). Now, no one would consider handling less than 1000 tons in that time. Several small batteries can, of course, be used, but there the elements of first cost, labour in operation, and current expenses must be considered. If diffusion is now to be considered seriously, we must look at the profit and loss account to be obtained, and as diffusion offers no advantage compared with milling as far as extraction is concerned, the gain must be in operating expenses and reduction of losses in manufacture, notably in the final molasses.

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[1] Summary of a paper presented to the 17th Annual Meeting of the Hawaiian Chemists' Association.

"If shredded cane can be used in diffusion, this may solve the problem of preparing the material, but it has not yet been proved that shredded cane tightly packed will allow of efficient circulation, and also that diffusion juice from shredded cane would be any purer than mixed juice from mills in which the cane has been prepared by shredding. The shredder disintegrates the cane to such an extent that all the soluble solids will be extracted by the diffusion process. It is therefore clearly apparent that there are several points to be cleared up definitely before diffusion will again become a live issue.

"No one will discard a good milling plant unless he can replace it by machinery very considerably its superior in operation and in cost, and while I am sure that the method of diffusion is the most simple for the extraction of sugar from the cane, I am also sure that to meet modern demands the batteries and equipment of 30 years ago will not serve, and considerable experimenting will require to be undertaken to demonstrate the efficacy of more modern equipment to be used with that process."

A communication from Egypt, where diffusion and milling are operated side by side at this time, was received by Dr. NORRIS from Mr. H. NAUS, Director-General of the Société des Sucreries et de la Raffinerie d'Egypte.

"In answer to your letter, I have the honour to inform you that we have still three systems of juice extraction:—(*a*) Cane diffusion; (*b*) bagasse diffusion; and (*c*) milling. Cane diffusion was, in fact, an enormous progress compared with all other proceedings at the time, but since then bagasse diffusion has been introduced and milling perfected so that the day is not far off where cane diffusion may be given up. It would take a volume to give a full and clear appreciation about each system, but we may say, in general lines, that the results with a cane of 12·5-13·5 per cent. and about 11 per cent. cellulose are as follows:

"Losses per cent. cane:—Cane diffusion, 0·35 to 0·45 per cent.; bagasse diffusion, 0·20 to 0·35 per cent.; milling, crusher and four mills (20 per cent. imbibition), 0·45 to 0·65 per cent.

"In proportion to the purity of the juice contained in the cane, the purity of the total raw juice is highest with the bagasse diffusion. Then follows cane diffusion and the milling processes, which last two do not show appreciable differences, there being perhaps a slight, but very slight, difference in favour of diffusion. Cane diffusion is more expensive than bagasse diffusion, and bagasse diffusion than milling."

After reading Mr. NAUS' letter on the three methods of extracting sugar from the cane, and considering that the data presented give the result of actual experience, one feels as if further argument in favour of diffusion were futile or should at least be postponed until more information from the Egyptian factories is available. According to the figures, the extraction for cane diffusion is 96·92 per cent.; for bagasse diffusion, 97·88 per cent.; and for milling, 95·77 per cent.

Without further knowledge of the machinery employed for slicing the cane, the treatment which the juices of the three systems receive before entering the evaporator, and the condition of the bagasse and its fuel value, the higher cost of cane diffusion over both bagasse diffusion and milling cannot be explained. The main difficulties of the process in Hawaii were:—(1) The high cost of handling the cane and the expensive machinery for its preparation for the batteries; and (2) the necessity for extra fuel, brought about by the production of a bagasse not dry enough for burning, and in too fine a condition for the furnaces of that time.

It was owing to the introduction of the Searby shredder a few years ago that diffusion came in for some consideration again in Hawaii. The great capacity of the shredder, and its successful operation so far, make it seem the proper machine for preparing the cane. It would materially cut down the operating expenses; but it will have to be demonstrated by practical tests whether the resulting material will be suitable for the diffusion process.

Assuming that the shredder is even, that there are no large pieces, will the cane thus disintegrated and dropped into the cells distribute itself evenly and allow a good circulation? The juice passing through the cells must come in contact evenly with all parts of the cane; there must be no hollow spaces or packing of the material; in other words, the juices must freely and rapidly pass through the filled cells and the extraction must be equally good in all parts of the diffuser. Whether shredded cane will fulfil these conditions must be left to a practical test.

The drying of the exhausted chips, and the burning of this rather powdery material, presented another serious problem in former years; but with the present improvements in mills, furnaces and boiler-house equipment, the exhausted shredded cane should be as efficiently burned as is the bagasse of to-day, and probably with less additional fuel, since much of the heavy machinery could be dispensed with.

It is possible that the above-mentioned difficulties are important factors in the higher cost of diffusion mentioned in Mr. NAUS' letter. The shredder, Messchaert grooves, and improved furnaces. seem to offer a solution for these difficulties.

Besides the economy in power, diffusion has in its favour the saving of labour and material, as neither settling tanks nor mud-presses are necessary. The juice is clarified in the cells, and after screening and heating goes directly to the evaporators. Following are a few figures representing the averages for a week's work at Makaweli in 1901, when diffusion was in operation:—Cane, 4637 tons. Cane, per hour, 34·5 tons. Cane juice:—Brix, 20·99; Polarization, 18·59; Purity, 88·58. Diffusion juice:—Brix, 17·83; Polarization, 15·43; Purity, 86·54. Extraction per 100 sucrose in cane, 97·0. Dilution, 17·5 per cent.

Cane juice was obtained by pressing the chips in a hand press. Noticeable is the low dilution, and one would expect that with 30 per cent. dilution or more, and with the finer material yielded by the shredder, an extraction of 98 per cent. and over should be realized.

Clarification and Filtration in Hawaii.[1]

By C. BUDDE.

Liming.—The lime used in Hawaii is mostly made locally from either coral rock or coral sand. Although not quite as good and pure as lime made elsewhere, its percentage of calcium oxide is sufficiently high and its silica and magnesia are low enough to give satisfaction in clarifying cane juices. Milk at 15° Bé. is generally preferred, although dry lime is used in some mills.

Great care should be taken to lime to a point which will give the clearest juice and highest increase in purity. Liming to neutrality is generally preferred, but very often alkaline or slightly acid tempering gives better results, which, of course, depends on the variety of the cane, or the soil, and the altitude of the field in which it is grown.

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[1] Paper presented to the 17th Annual Meeting of the Hawaiian Chemists' Association.

In an experiment made with Caledonia cane juice, the increase of purity resulting from acid, neutral, and alkaline clarification was 1·1, 1·7, and 2·2° respectively.

Liming mostly takes place before heating of the juices. As far as I know, the Maui Agricultural Company is the only place where the juices are limed after having passed through the heater, the advantage being that the heater tubes are free from scale at the end of the week. Mr. Foster reports that he never found any inversion, obtained a good clarification, and that the heater tubes remained free of scale at all times. I believe, however, that there are possibilities of getting a heavier scale on the evaporator tubes.

Heating.—The Deming system of heating juices is generally used here in Hawaii, and is so well known that it needs no description. As to the temperature of juices leaving the heater, 212° to 216°F. is generally accepted as safe without any risk of destroying sucrose or darkening the colour of the juice. Some are of the opinion that even a temperature of 220°F. could be used, provided the juice is not heavily over-limed, as the time of exposure is very short, and the temperature drops back to 212° F., and lower, as soon as the juices are discharged into the settling tanks.

On the other hand, Mr. Walker, of the Pioneer Mill Company, and Mr. Biela, of the Kohala Sugar Company, believe in a temperature below boiling point, as low as 180° F., to reduce decomposition to the minimum and prevent the undue viscosity of syrups and molasses, and the consequent slow drying of massecuites. Mr. Walker states that he worked for two weeks at 200° F., and at times at 190° F., and obtained a good clarification. The reason he did not continue at this temperature during the whole season was that he did not have sufficient evaporator capacity to take care of the colder juices. Next year, however, he will install a reheater that will do away with this trouble.

Settling Tanks.—There are various kinds of settling tanks in use in Hawaiian mills, and all are understood to be giving satisfaction. At Honolulu Plantation we have 22 asbestos-covered inverted cone-bottom tanks, each having a capacity of 1000 gallons. The mud outlets are in the centre, and the tanks can easily be emptied and washed out occasionally. The juice outlet is at the side of the tank just above the cone bottom. To this outlet inside the tank, double elbows connect a 3 in. copper pipe, supplied with a copper float. At the float end of the pipe there is a right-angle connexion 3 in. long. This extends down into the juice below the scums, and as the double elbows are movable, the float descends with the level of the juice until the mud is struck. With fairly good and clean cane, about 90 per cent. is recovered as clarified juice. Pipes, floats and trough in front of tanks have all been made out of old Lillie evaporator tubes, and since their installation have not given any trouble whatsoever.

Double-screening of the juices is generally replacing sand and excelsior filters. Rotary self-cleaning screens are being used in some mills, but mostly screens 3 ft. wide and from 6 to 8 ft. long placed at an angle of about 30° in order to allow the juice to keep the screen clean (by pushing forward the cush-cush) are being installed. The mesh of the screens varies from 80 to 200, and is reported to give general satisfaction.

Resettling tanks are gradually being discarded here in Hawaii. The clear juice is drawn off in the same way as in the settling tanks, and about 40 per cent. is recovered as clarified juice. During this last season at this factory we ran without them for one month, but had to adopt them again, as our filter-press capacity is below standard and the amount of filter-press cloth necessary increased during that time.

Those answering the question, "Where should the resettled and filter-press juice be returned?" agreed that it should be returned to mixed juice, as this is usually overlimed and might cause a heavier scale in evaporators. Moreover, it falls upon the evaporator to raise the temperature of the filter-press juice to that of the clarified juice. In any case, piping should be so arranged to either return the juice to mixed juice tanks or to evaporator supply tank.

Filter-press.—As far as I know, plate-and-frame presses of different types are used in the local mills. The size of the plates and thickness of frames have gradually been increased, and have reached a maximum of 34 in. for plates and 4 in. for frames at the Maui Agricultural Company's mill at Paia.

At Honolulu Plantation we have 11 small presses and one large Catton & Neill press. How much more economical in time, labour, water, and filter-press cloth a large press is than a small one can be seen by comparing the following data:—

Size of frames.	No. of frames	Filtering area, sq ft.	Mud capacity, tons.	Time of filling.	Time of Sweetening off.	Total tons mud per press per season.	Total yards cloth per press per season.	Yards cloth per ton of mud.	Cost cloth per ton of mud per season.	Excess expense of cloth in small machine per cent. big machine per ton mud.
				hr.	hr.				$	Per cent.
24	36	275	0·525	4	4	336·86	39c per yd.	1·083	0·422	66·0
						7·48%	365			
34	44	706	1·25	2	3	798·56	55c per yd.	0·462	0·254	—
						17·73%	368			

In charging and sweetening off the presses the gravity system is considered very good practice, but pumps and montejus are still being used to a great extent.

The double filter-press system continues to find more followers; and although it requires more labour, as the mud has to be handled twice, it is considered more nearly "fool-proof" in getting the sucrose out of the cake. Hydraulic closing devices should be installed wherever possible. An even pressure can be put on the presses with less labour and time, and the danger of breaking plates is reduced considerably.

Now and then it becomes necessary to employ other clarifying agents besides lime, such as phosphoric acid paste, kieselguhr, etc., in order to get a good clarification or a lighter-coloured juice. Towards the end of this season the Waialua Agricultural Company had a run of exceptionally dark juices, from Rose Bamboo and D1135 cane, which were very dirty and hard to clarify. Mr. L. W. HOWARD has made a report on this; he points out that his experiments proved conclusively that we must *overlime* the juices heavily, and precipitate the excess lime by means of phosphoric acid in some form. He believes that the smaller the amount of "cush-cush" in the mixed juice the better and easier will the work at the liming station be for all the juices, and especially for those from such canes as he has had great difficulty in handling.

At Kahuku, Mr. S. S. PECK is using a molasses carbon for clarifying and decolorizing the juices, and is turning out a very good quality of white sugar.

In connexion with the bone-char filters at Honolulu plantation, we use phosphoric acid and lime in clarifying the raw liquor (remelted raw sugar) and obtain a very clear liquid. This is very important, as the life of a char filter and the amount necessary for decolorizing depend on it a great deal.

Publications Received.

Alcohol: its Production, Properties, Chemistry, and Industrial Applications. By Charles Simmonds, B.Sc. 1919. 574 pages. (Macmillan & Co., London.) Price: 21s. net.

Several works have been published on the production of alcohol and its industrial uses, each of service from its particular manner of treating the subject; but manufacturers of spirit (especially those in the tropics) have for some time past expressed their need of a practical modern handbook dealing particularly with the chemical and biological aspects of this branch of technology. Mr. SIMMONDS has written a work which to some extent should meet this want. It is a general monograph, compiled from several sources, carefully written, well illustrated, and wide in scope. In addition to dealing with such matters as the raw materials and biological agents (enzymes and yeast) employed, and the processes of saccharification and fermentation followed, considerable space is devoted to themes as industrial alcohol; denaturation; alcohol as a source of light, heat, and power; examination of potable spirits; while lastly there is a chapter on the physiological effect of alcohol. Questions which at present are occupying more or less attention in different quarters, such as the production of alcohol from wood by the Classen process, from sulphite waste liquor by Ekström and Wallin's patents (now being operated on a large scale in Sweden), and by synthetic methods using calcium carbide, are adequately discussed. There is also a very instructive chapter on the use of alcohol as a fuel for motor engines. It is, therefore, a very comprehensive work, one which we think may come to be regarded as a standard general book on the subject. Those sections dealing with the chemistry of alcohol, the analysis of spirits and excise regulations are valuable, and reflect Mr. SIMMONDS good experience in these directions. More space, and especially more practical data, however, might have been allotted to the treatment of the all important operation of fermentation (to which unfortunately only some 6-7 pages are devoted); while the subject of the application of pure yeast should surely have also been discussed in greater detail. We hope that in a future edition these sections will be expanded, at the expense if need be of less useful data, such as those appertaining to the general chemistry of the alcohols and their physical data, for which information one naturally would have recourse (when necessary) to well-known sources.

Recent Advances in Organic Chemistry. By Alfred W. Stewart, D.Sc. (Longmans, Green & Co., London.) Third edition, 1919. Price, 14s. net.

Chemists specializing in some branch or other of technology realize not long after their student days are over the difficulty, or generally the impossibility, of keeping themselves abreast of the whole trend of organic research. A book such as the one before us, which summarizes the work done in organic chemistry during the past ten years, and which, moreover, does so in an eminently lucid and interesting manner, is certain of appreciation. It is by no means a mere compilation of facts; but rather an exposition of the principles upon which the science is developing. There are chapters on subjects such as the terpenes, the alkaloids, rubber, polypeptides, anthocyanins, and modern formulae and their failings; but the sections which will be found most useful to sugar chemists are those discussing the chlorophyll problem and some theories of the natural synthesis of vital products. In writing this latter section, Dr. Norman Collie's communications to the author giving his views on the subject have been largely embodied in the text; and the result is a critical examination of recent work done on the methods by which natural products as carbohydrates, proteins, pigments, may possibly come into existence in the organism. We are still far from a definite knowledge of the manner in which the vital machine carries out its work, but the theories collected in this chapter allow the reader to speculate for himself on the subject, and reveal a fascinating field of study.

Reagents and Reactions. By Edgardo Tognoli; translated by C. Ainsworth Mitchell, B.A., F.I.C. (J. & A. Churchill, London.) Price, 6s. net.

This small book is novel in its purpose, and we may add also distinctly useful. It gives a description of the principal reactions that have been proposed for the detection of different organic and inorganic substances, either alone or in the presence of other compounds. Every chemist, whether engaged in analytical or in research work, requires constantly to establish the presence or absence of substances such as nitrous and nitric acids, peroxides, peroxydases, aldehydes, sugars, proteins, phenols, diazo compounds, alkaloids, dyestuffs, etc., etc.; and it is a considerable convenience to have the several reactions which are used for the identification of these bodies collected in one volume, a task which, we think, has not previously been attempted in English. These tests are described in the text according to the name of the investigator who first proposed them; but in order to facilitate reference a collective index is also given of the various substances. Mr. Mitchell has enhanced the value of the original Italian edition by the addition of some of the more important reactions not formerly included. It may be pointed out that many of the tests described belong to the domain of physiological chemistry, while some are now regarded as obsolete. It must be admitted also that the value of a number has yet to be proven. Nevertheless, this small book will certainly be of much service to chemists; and its usefulness will, we hope, be increased as succeeding editions appear.

Report of the Government Chemist for the year ending March 31st, 1919. (H.M. Stationery Office, Imperial House, Kingsway, W.C. 2) 1919. Price: 2d.

Samples of sugar are examined in the Government Laboratory on importation as well as on exportation on drawback. Glucose, molasses, saccharin were also tested. In the case of preparations containing sugar, generally these are of so great a variety that it has been found necessary to adopt fixed rates of duty when regularly imported or exported; but there are also many articles which it has not been found practicable to treat in this way, and which have therefore to be separately analysed on each importation or exportation. Other common articles sent for test were egg-yolk, gelatin, glue, honey (when adulterated with invert sugar), meat extracts, parchment papers, tanning extracts, and printers' roller compositions. Altogether the number of samples examined for assessment of duty or drawback during the year under review was 23,727.

Annual Reports of the New York State College of Agriculture at Cornell University and the Agricultural Experiment Station, 1914-1917. Four volumes. (Published by Cornell University, Ithaca, New York, U.S.A.)

Much valuable work is being carried out at the Agricultural Experiment Station, Ithaca, New York, and the bulletins emanating from that institution attract considerable attention. Its activities include farm management; farm practice; plant breeding; botany; plant pathology; pomology; entomology; floriculture; vegetable gardening; forestry; dairy industry; animal and poultry husbandry; and rural engineering; in each of which subjects there are separate departments to which a staff of highly qualified specialists is attached. These reports include the numerous articles which have been published by the station staff upon a wide range of subjects, practical and theoretical, and demonstrate the excellent character of the work which they are accomplishing.

Commercial Comb-Honey Production. George S. Demuth. Contribution from the Bureau of Entomology; Farmers' Bulletin 1039. (Superintendent of Documents, Government Printing Office, Washington, D.C., U.S.A.) 1919. Price: 5 cents.

Brevities.

The American Sugar Refining Company have purchased the Central Cunagua on the north coast of Camaguey Province, Cuba. The property consists of about 110,000 acres of land and a completely electrified double tandem factory with a rated capacity of 600,000 bags (85,700 long tons). The cane lands are virgin soil recently cleared of forest, and the factory equipment is new and of the most modern type.

We regret to record the death of Mr. P. Bonâme on the 10th of December at Mans (Sarthe), France. The deceased was greatly esteemed in Mauritius, where he held the position of Director of the Station Agronomique, from which appointment he retired in 1914, having held it since 1893. He was the first President of the Société des Chimistes de Maurice.

Canadian investors are showing increased interest in Cuban properties; it is announced in *Facts about Sugar* that the Cuban-Canadian Company have acquired the mill and plantation property of the Rio Cauto central, Oriente, Cuba, from the American owners. This mill has a maximum capacity of 35,700 long tons, and its cane area amounts to 32,300 acres, of which 60 per cent. is administration cane and 40 per cent. that of *colonos*.

A control of sugar prices was recently established by law in Canada which limited the refiners' net profits to a sum not exceeding two-fifths of a cent per lb. The wholesalers are limited to a commission of 5 per cent. which will be paid to them by the refiners and is included in the refiner's list price. The refiners' list price is to be the one at which the wholesaler will sell to the retailer.

The amount of sugar exported from Fiji during 1918 was 63,070 tons as compared with 97.335 tons in 1917. The decrease was due partly to a drought, and partly to a reduction in area caused by a shortage of labour. This latter was caused by the disorganization of the system of Indian immigration, on which the Fiji sugar industry is absolutely dependent for a regular supply of labour.

The sugar production, which is one of the chief industries of Dutch Guiana, suffered in 1918 from lack of labour and the high price of supplies, though the latter was partly offset by the good prices received for the finished product. Sugar to the value of nearly £20,000 was exported to French Guiana during the year, most of it to be turned into rum. The total value of the sugar exported was about £188,000

At the Chemical Industry Club, Newcastle, Mr. F. H. Walker, B.Sc., in a paper[1] entitled "Soil Bacteria," said that the attempt to put bacterized peat on the market as "Humogen" had not been altogether successful, although in small scale experiments raw peat treated with steam, and afterwards inoculated with a mixture of *B. radicicola* and *Azobacter chroococcum* had given remarkable successes in stimulating the growth of plants.

In commenting upon the relative sweetness of sugars, W. H. Th. Harloff[2] recently remarked that when palm sugar (which is exceedingly sweet and luscious) is dissolved in water and treated with a decolorizing carbon (which would adsorb most of the non-sugar substances), one obtains a nearly colourless liquid that has entirely lost its original flavour. It then appears to be much less sweet than the original solution, although its content in sucrose and reducing sugars may be the same.

Some figures relating to the use of alcohol and other fuels in motor vehicles were given by Dr. T. Blackwood Murray in the course of his address as President of the Institution of Engineers and Shipbuilders in Scotland. In France, some years ago, a mixture of 50 per cent. alcohol, 35 benzole, and 15 petrol was tried in comparison with pure benzole and pure petrol. The results showed that 46·3 gross ton-miles were obtained per gallon of alcohol mixture; while for petrol and benzole the corresponding figures were 53·2 and 57 1 respectively. He is confident that denaturated alcohol could be delivered to the consumer in the United Kingdom at a figure at which, (taking the current prices of petrol and benzole as 3s. 0½d. and 2s. 9d. per gallon respectively), the cost per ton-mile would be 0·53d. for alcohol mixture, 0·578d. for benzole, and 0·686d. for petrol.

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[1] *Chemical Trade Journal*, 1919, **65**, No. 1697, 608.

[2] *La. Planter*, 1919, **63**, No. 4, 62.

In Cochin China, it is reported by P. QUESNEL,[1] cane is cultivated by the natives on about 11,000 acres in the eastern provinces. A yellow variety, *mia-vang*, yields 17·5 tons per acre; and a red one, *mia-ly*, 11·5 tons.

The latest estimates of the crop of sugar beet seed produced in the United States during 1919 show that approximately 3350 short tons of seed will be obtained from 11,100 acres, or 600 lbs. per acre on the average. This total is greater than that of 1918 by 400 tons and of 1917 by 810 tons. While this production does not cover the total requirements in seed of the American beet sugar crop, which needs about 7500 tons annually, it is evident that the United States is steadily achieving the object of being independent of other countries for its seed supplies.

Writing on the subject of the manufacture of glycerin from molasses, Dr. PRINSEN GEERLIGS[2] says, that the experiments of CONNSTEIN and LUEDECKE[3] published during the war have led to an output of over 1000 tons of this product per month in the factories of the Protol Company of Germany.[4] In practice 20 to 25 per cent. of the sugar is converted into glycerin, while the by-products, alcohol and aldehyde, find a ready market. In certain cane-growing countries the problem of the utilization of molasses is rather an acute one and Dr. GEERLIGS adds that "it appears to me that it would be worth while to give this matter some thought in order to find out whether it would not be possible to produce glycerin commercially from Java molasses."

The question of using tractors instead of oxen for ploughing on sugar plantations is occupying attention in certain countries, and developments in this direction may be expected in the near future. In Cuba a mill in Cienfuegos now has six in operation, and it is found that in addition to saving in labour, work is much more uniform[5]. Tractors have also been found of service in lifting beets in France,[6] the advantages observed being that such a lifter does not deviate from a straight line, as always happens with a team of horses; that no roots are damaged; that the cost of the work is not greater than that of a team; and that it is done more quickly, leaving free the teams which are urgently required for other work at the time. On an average three hectares are lifted per day with a consumption of petrol of about 22 litres.

Sir JAGADIS CHANDRA BOSE[7] recently gave a lecture at the India Office, London, dealing with some aspects of the work being done at the Bose Research Institution, Calcutta. By means of the "crescograph" it had become possible to study the life activity of the growing plant; and the lecturer demonstrated this effect by a spot of light rushing across a 10 ft. scale in the course of 12 seconds, the actual rate being about a hundred thousandth part of an inch per second. The effect of stimulating and depressing chemical agents was also shown. He pointed out that the possibility of modifying the rate of growth is a matter of great practical importance. Of infinitely greater importance, however, is the fundamental unity of life which it had been possible to establish between plants and animals, shown by the spontaneous pulsation in certain plant tissues corresponding to heart-beat in animals, and by the identical effect of anæsthetics, stimulants, and poisons, and in the death spasm occurring in both.

In Formosa the total production of molasses is about 130,000 gallons, of which about 87 per cent. is used for the production of alcohol, and about 8 per cent. is exported. MIGAKU ISHIDA, of the Government Experiment Station, states in a recent report that he is investigating the utilization of this by-product, and is studying its purification; the removal of the invert sugar from it; its use in the preparation of fodder; its use as fertilizer; its use as fuel; and its solidification. A patent has been taken out for a process based on the neutralization of the material with lime, followed by a precipitation of gums and pectins with alcohol, a purified syrup being obtained, and the alcohol recovered. When used as fuel, the molasses is mixed with bagasse at the rate of 4 or 5 per cent. Applications as fertilizer may be made at the rate of 400 lbs. per acre either two weeks before planting, or at the time of planting, or again four weeks after the canes have sprouted. It may be used in conjunction with sulphate of ammonia and sulphate of potash, and the presence of the sugars and other constituents appears to stimulate the absorption of phosphate by the cane.

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[1] *Congrès d'Agriculture coloniale, Gouvernement général de l'Indochine*, Saigon Series, *Bulletin No. 1, 1918.*

[2] *La. Planter*, 1919, 63, No. 17, 268-269.

[3] *Berichte*, 1919, 1305.

[4] See also ADAMS AND EOFF. *I.S.J.*, 1919, 340; and SCHWEIZER, *I.S.J.*, 1919, 412.

[5] *Farm Implement News*, 1918, 39, No. 40, 27.

[6] E. PLUCHET, *Comptes rendus*, 1918, 4, No. 34, 940-945

[7] *The Times*, December 16th, 1919.

Review of Current Technical Literature.[1]

Ost's Solution, and its Advantages compared with Fehling's Solution for the Determination of Reducing Sugars. *P. Beyersdorfer.* *Zeitschrift des Vereins der deutschen Zuckerindustrie, 1919, No. 765, 403-443.*

It is well recognized that Fehling's solution possesses the marked disadvantage of attacking sucrose to an extent that is not inconsiderable, reducing substances being formed, for the presence of which an allowance must be made in the case of products containing a large proportion of the disaccharide and a small amount of invert sugar. This effect of Fehling's solution is due to the large amount of free sodium hydroxide present in it. Soldaini[2] and other chemists[3] endeavoured to overcome the defect by using a solution of copper bicarbonate, but the reagent prepared according to their formulae did not give very satisfactory results. Its effect upon sucrose was certainly less than that of Fehling's solution; but it did not keep well; it deposited copper hydroxide; and it precipitated lime and other mineral impurities from the sugar product being examined. Ost,[4] however, was more successful in preparing a more generally stable and reliable copper bicarbonate liquor, and this he did by adding a solution of copper sulphate to a solution containing both potassium carbonate and bicarbonate, instead of dissolving up copper carbonate in a solution of potassium bicarbonate as some others had done. Schmoeger[5] reported rather favourably upon this formula; later Ost himself[6] published particulars of a further study of his reagent; while more recently Degener[7] broke a lance over it. Herzfeld, in 1888, had declared that if the defects of Soldaini's solution could be overcome, chemists would lose no time in abandoning Fehling's solution and in adopting the new reagent. Dr. Beyersdorfer, as the result of a long and thorough examination of the question, has come to the conclusion that, although Ost's solution may not be regarded as an altogether ideal reagent, it is preferable at any rate to Fehling's solution. His results are of interest to the sugar factory and refinery chemist for the realization of the most accurate conditions of determining the reducing sugars in their products; and his contribution will doubtless induce others to take up the investigation of this very important question.

Ost's solution is prepared by dissolving 250 grms. of potassium carbonate and 100 grms. of potassium bicarbonate (both chemically pure) in about 700 c.c. of water contained in a litre flask, this operation being facilitated by heating in a water-bath at 60-80°C. and frequently shaking. The mixture is cooled, and a solution containing the desired amount of copper sulphate added in small amounts at a time, meanwhile well agitating.[8] After making the liquid up to the 1000 c.c. mark and mixing, it is passed through a hardened filter, and its value established against a solution of invert sugar. Two solutions should be prepared, the first the so-called "normal solution" containing 4 grms. of copper (Cu) per litre,[9] which is used for general purposes; and the second, the "fifth normal solution" containing only 0·8 grm.,[10] which serves for the examination of products (such as those of the refiners) containing much sucrose and little invert sugar. This weaker solution is prepared from the stronger by mixing one volume of the latter with four of a filtered solution containing 250 grms. of potassium carbonate and 100 grms. of potassium bicarbonate. It is more sensitive than solutions of higher copper content and it attacks sucrose less. In determining the cupric reduction by means of Ost's solution, 75 c.c. of the copper test is mixed with 50 c.c. of the assay solution in a 125 c.c. flask, and the volume of the mixture adjusted to the mark (if necessary). This flask is immersed in a boiling water-bath for 15 minutes in the case of the N/5 liquor, and for 20 in that of the N/1 solution. At the end of the period, the amount of cuprous oxide precipitated is ascertained by Bertrand's volumetric method,[1] in which the precipitate is dissolved in a solution of a ferric salt, and the amount of ferrous salt formed is found by titration with standard permanganate solution. Bertrand's process, it is considered, yields very reliable results, while being very much less tedious than the gravimetric procedure. Finally, the percentage of invert sugar is calculated from the two tables here reproduced. The first is for use with the N/5 solution, that is, for the determination of quantities of invert sugar less than 20 mgrms in the 50 c.c. of solution taken for the analysis with 10 grms. of sucrose. The second table is for use with the N/1 solution in all cases, and the 50 c.c. of sugar solution, which is mixed with the 75 c.c. of Ost's solution, should contain less than 100 mgrms. of invert sugar. An example of the method of using the tables may be given: 10 grms. of a sugar polarizing 78·8° were dissolved in 50 c.c. of water, and the cupric reduction determined in the manner indicated; 100 mgrms. of Cu were found, and as the amount of sucrose present in the 50 c.c. was in round figures 8 grms., the invert sugar content from the second table is 24·8, or 0·25 per cent. of the sample.

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[1] This Review is copyright, and no part of it may be reproduced without permission.—(Editor, *I.S.J.*)

[2] *Zeitschrift*, 1886, 625; 1888, 628. [3] *Ibid.*, 1889, 733; 1889, 933: 1890, 179; 1890, 964. [4] *Ibid.* 1890, 361; 1891, 97. [5] *Ibid.*, 1891, 785. [6] *Ibid.*, 1895, 938. [7] *Deutsche Zuckerindustrie*, 1897, 71.

[8] By adhering to these conditions, any evolution of carbon dioxide is avoided.

[9] Corresponding to 15·71 grms. of $CuSO_4$, 5 H_2O.

[10] Corresponding to 3·14 grms. of $CuSO_4$, 5 H_2O. Fehling's solution contains 34·639 grms. of $CuSO_4$, 5 H_2O per litre, corresponding to 8·82 grms. of Cu.

TABLE I.—*For use with "Fifth Normal" Ost's Solution; quantity of Sucrose, 10 grms.; quantity of Invert Sugar, 1-21 mgrms.*

Invert Sugar, mgrms.	Cu, mgrms.	Invert Sugar, mgrms.	Cu, mgrms.	Invert Sugar, mgrms.	Cu, mgrms.	Invert Sugar, mgrms.	Cu, mgrms.
1 ..	9·0	6 ..	22·8	11 ..	35·6	16 ..	47·6
2 ..	11·8	7 ..	25·4	12 ..	38·1	17 ..	49·9
3 ..	14·6	8 ..	28·0	13 ..	40·5	18 ..	52·1
4 ..	17·4	9 ..	30·6	14 ..	42·9	19 ..	54·3
5 ..	20·1	10 ..	33·1	15 ..	45·3	20 ..	56·5
						21 ..	58·6

It is of interest to draw attention to some other of the more striking results obtained in this research. Using in both cases 10 grms. of refined sugar, and operating according to the Herzfeld gravimetric process, the cupric reduction was found to be 30 mgrms. with Fehling's solution and only 3·8 in the case of Ost's. When arriving at the decision to use 75 c.c. of the copper test liquor (instead of a more convenient volume of 50 c.c.), 10 grms. of sucrose were dissolved in 25 c.c. of water, mixed with 25, 50, 75, and 100 c.c. of the copper bicarbonate solution, made up to 125 c.c. with water, and the reduction determined. It was found that the greater the volume of the test liquor, the *less* was the sucrose attacked, the four quantities giving 22·2, 21·0, 15·2 and 11·4 mgrms. of Cu respectively. This result is explained by the facts that the greater the concentration of hydroxyl ions, the greater the destruction of sucrose; and that the more the copper bicarbonate solution is diluted with water (to make up the volume to the 125 c.c. mark) the greater is the dissociation of the potassium carbonate. This enables one to understand why Fehling's solution attacks sucrose under the same conditions as strongly as the Soxhlet,[2] Meissl,[3] and Herzfeld[4] liquors, and to a greater extent than Kjeldahl's.[5] In regard to sensitiveness, it was found that 1 mgrm. of invert sugar in the presence of 10 grms. of sucrose could be detected by Ost's solution; whereas it is uncertain whether 5 mgrms. of invert sugar with 10 of sucrose can be detected by Fehling's. It is difficult yet to pronounce upon keeping quality and constancy of titre, but it was found that Ost's solutions having 0·8 to 4·0 grms. of Cu per litre, contained in white glass flasks, standing on a window-sill exposed to sunlight, were unchanged after two months. Lastly, it may be mentioned that one equivalent of invert sugar reduces three of copper with Ost's solution but only two in the case of Fehling's.

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[1] *I.S.J.*, 1915, 236; 1919, 354.

[2] *Zeitschrift*, 1878, 368. [3] *Ibid.*, 1879, 1034. [4] *Ibid.*, 1885, 967. [5] *Scheibler's neuer Zeitschrift für Rubenzuckerindustrie*, 37, 21.

TABLE II.—*For use with "Normal" Ost's Solution; quantity of Sucrose, 10 grms.; quantity of Invert Sugar, 100 mgrms.*

Cu, mgrms.	SUCROSE PRESENT, grms.											
	0	1	2	2·5	3	4	5	6	7	8	9	10
5	3·8	1·6	—	—	—	—	—	—	—	—	—	—
10	5·1	3·0	2·0	1·5	1·1	—	—	—	—	—	—	—
15	6·4	4·3	3·4	2·9	2·5	2·1	1·7	1·4	1·2	—	—	—
20	7·8	5·7	4·7	4·2	3·8	3·4	3·0	2·7	2·5	2·3	2·1	1·9
25	8·1	7·0	6·1	5·6	5·2	4·8	4·4	4·1	3·9	3·6	3·4	3·2
30	10·4	8·4	7·5	7·0	6·6	6·2	5·8	5·5	5·2	5·0	4·8	4·6
35	11·8	9·7	8·9	8·4	8·0	7·5	7·1	6·8	6·6	6·4	6·2	6·0
40	13·2	11·1	10·3	9·8	9 4	8·9	8·5	8·2	8·0	7·7	7·5	7·3
45	14·5	12·5	11·7	11·3	10·9	10·4	9·9	9·6	9·4	9·1	8·8	8·6
50	15·9	13·9	13·1	12·7	12·3	11·8	11·3	11·0	10·8	10·5	10·2	9·9
55	17·3	15·3	14·5	14·1	13·7	13·2	12·7	12·4	12·2	11·9	11·6	11·3
60	18·7	16·7	15·9	15·5	15·2	14·6	14·1	13·8	13·6	13·3	13·0	12·7
65	20·1	18·1	17·3	16 9	16·6	16·1	15·6	15·3	15·0	14·7	14·4	14·1
70	21·5	19·6	18·8	18·4	18·0	17·5	17·0	16·7	16·4	16·1	15·8	15·5
75	22·9	21·0	20·2	19·8	19 5	18·9	18·4	18·1	17·8	17·5	17·2	16·9
80	24·3	22·5	21·7	21·3	20·9	20·4	19·9	19·6	19·3	19·0	18·7	18·4
85	25·8	24·0	23·2	22·8	22·4	21·8	21·3	21·0	20·7	20·4	20·1	19·8
90	27·2	25·4	24·6	24·2	23·9	23·3	22·8	22·5	22·2	21·8	21 5	21·2
95	28·6	26·9	26·1	25·7	25·4	24·8	24·3	24·0	23·7	23·3	23·0	22·7
100	30·1	28·4	27·6	27·2	26 8	26·3	25·8	25·5	25·2	24·8	24·5	24·2
105	31·6	29·9	29·1	28·7	28·3	27·8	27·3	27·0	26·7	26·3	25·9	25·6
110	33·0	31·4	30·6	30·2	29·8	29 3	28·8	28 4	28·1	27·7	27·4	27·1
115	34·5	32·9	32·1	31·7	31·3	30·8	30·3	29·9	29·6	29·2	28·9	28·6
120	36 0	34 4	33·6	33·2	32·8	32·3	31·8	31·4	31·1	30·7	30·4	30·1
125	37·5	35·9	35·1	34·7	34·4	33·8	33·3	32·9	32·6	32·2	31·9	31·6
130	39·0	37·4	36·6	36·2	35·9	35·4	34·9	34·5	34·2	33·8	33·5	33·2
135	40·5	39·0	38·2	37 8	37·4	36·9	36·4	36·0	35·7	35·3	35·0	34·7
140	42·0	40·5	39·7	39·3	38·9	38·4	38·0	37·6	37·2	36 8	36·5	36·2
145	43 5	42·1	41·3	40·9	40·5	40·0	39·5	39·1	38·8	38·4	38·1	37·7
150	45·1	43·7	42·8	42·4	42·0	41·5	41·1	40·7	40·4	40 0	39·6	39·3
155	46·6	45·2	44·4	44·0	43·6	43·1	42·7	42·3	41·9	41·5	41·2	40·9
160	48·2	46·8	46·0	45·6	45·2	44·7	44·2	43·8	43·5	43·1	42·8	42·5
165	49 7	48·4	47·5	47·1	46·7	46·2	45·8	45·4	45·1	44·7	44·4	44·1
170	51·2	50·0	49·1	48·7	48·3	47·8	47·4	47·0	46·7	46·3	46·0	45·7
175	52·8	51·5	50·7	50·3	49·9	49·4	49·0	48·6	48·3	47·9	47·6	47·3
180	54·4	53·0	52·2	51·8	51·5	51·0	50·6	50·2	49·9	49·5	49 2	48·9
185	56·0	54·6	53 8	53·4	53·1	52·6	52·2	51·8	51·4	51·1	50·8	50·5
190	57·7	56·2	55·4	55·0	54·7	54·2	53 8	53·4	53·0	52·7	52 4	52·1
195	59·4	57·9	57·1	56·7	56·3	55·8	55·4	55·0	54·6	54·3	54·0	53·7
200	61·2	59·6	58·8	58·4	58·0	57·5	57·1	56·7	56·3	56·0	55·7	55·4
205	62·9	61·3	60·5	60·1	59·8	59·3	58·8	58·4	58·0	57·7	57·4	57·1
210	64·7	63·1	62·3	61·9	61·5	61·0	60 6	60·2	59·8	59·5	59·2	58·9
215	66·6	64·9	64·1	63·7	63·3	62·8	62·4	62·0	61·6	61·3	61·0	60·7
220	68·4	66·8	66·0	65·6	65·2	64·7	64·2	63·8	63·4	63·1	62·8	62·5
225	70·3	68·7	67·9	67·5	67·1	66·6	66·1	65·7	65·3	65·0	64·7	64·4
230	72·3	70·6	69·8	69·4	69·0	68 5	68·1	67·6	67·2	66·9	6·66	66·3
235	74·3	72·6	71·8	71·4	71·0	70·5	70·1	69·6	69·2	68·9	68·6	68·3
240	76·3	74·6	73·8	73·4	73·1	72·6	72·1	71·6	71·2	70·9	70·6	70·3
245	78·3	76·6	75·8	75·4	75·1	74·6	74·2	73·7	73·3	72·9	72·6	72·3
250	80 4	78·7	77·9	77·5	77·2	76·7	76·3	75·8	75 4	75·0	74·7	74·4
255	82·5	80·9	80·1	79·7	79·4	78·9	78·5	78·0	77·6	77·2	76·8	76·4
260	84·6	83·0	82·3	81·9	81·6	81·1	80·7	80·2	79 8	79·4	79·0	78·0
265	86·8	85·2	84·5	84·1	83·8	83·3	82·9	82·4	82·0	81·6	81·2	80·8
270	89·0	87·5	86·8	86·4	86·1	85·6	85·2	84·7	84·3	83·9	83·5	83·1
275	91·2	89·8	89·1	88·7	88·4	87·9	87·5	87·0	86·6	86·2	85·8	85·4
280	93·5	92·1	91·4	91·0	90·7	90·3	89·9	89·4	89·0	88·5	88·1	87·7
285	95·8	94·5	93·8	93·4	93·1	92·7	92 3	91·8	91·4	90·9	90·5	90·1
290	98·1	96·9	96·2	95·9	95 6	95·2	94·8	94·3	93·9	93·4	92·9	92·4
295	100·5	99·3	98·7	98·4	98·1	97·7	97·3	96·8	96·4	95·8	95·3	94·8
300	102·9	101·8	101·2	100·9	100·6	100·2	99·9	99·4	98·9	98·3	97·8	97·3

Changes in the Calorific Value of Cane Juice during Clarification and Evaporation. *C. A. Browne. Journal of the American Chemical Society, 1919, 41, No. 9, 1434-1440.*

As regards the calorific value of the products produced by decomposition during clarification and evaporation, a triple illustration may be made: (1) little or no change in calorific value, as in the formation of lactic and saccharinic acids from invert sugar; (2) a decrease, as in the formation of invert sugar from sucrose; and (3) an increase, as in the formation of dehydration products, such as caramel, saccharin, glucinic acid, and humoid derivatives. As regards the organic non-sugars alone, operations in the syrup house and sugar factory would tend on theoretical grounds to cause an increase in their calorific value. On the other hand, the filtration of molasses over bone-black might produce a variable result according to the selective action of the char upon the non-sugars of lower calorific value (as aconitic and aspartic acids) and upon those of higher calorific value (as glucinic acid and its dehydration products). The latter being in excess in ordinary cane molasses, filtration over char would tend to eliminate more salts of glucinic acid than of aspartic or aconitic acid. These general deductions have been in large part confirmed by the following practical tests made with eight samples, namely: (1) clear mother-liquor obtained from unclarified cane juice by evaporation and separation of as much sucrose as possible; (2) open-kettle molasses resulting from juice treated with sulphur dioxide and lime; (3) first molasses (Cuban) from juice clarified with lime alone in the ordinary way; (4), (5), (6), (7), samples of refiners' syrups; (8) refiners' low-grade molasses (black-strap). The following are the results that were obtained:—

	1	2	3	4	5	6	7	8
Water	29·64	28·16	24·91	17·85	16·77	17·30	18·51	19·60
Invert sugar	13·93	14·28	12·84	29·72	33·18	31·19	26·76	22·53
Sucrose	49·86	51·92	48·13	36·12	38·00	37·57	41·58	37 87
Ash	3·60	2·50	4·82	5·30	4·46	5·97	4·04	6·53
Undetermined organic matter	2·97	3·14	9·30	11·01	7·59	7·97	9·11	13·74
Alkalinity of ash (c.c. N/10acid neutralizing 1 grm.)	51·2	92·9	64·2	81·5	77·0	102·2	123·4	126·2
Calories per grm. of solids[1]	3·661	3·765	3·726	3·640	3·675	3·600	3·715	3·685
Calories of the sucrose per grm. of solids	2·803	2·858	2·535	1·739	1·805	1·797	2·018	1·863
Calories of the invert sugar per grm. of solids	0·743	0·746	0·641	1·357	1·495	1·414	1·232	1·051
Calories of total sugars per grm. of solids	3·546	3·604	3·176	3·096	3·300	3·211	3·250	2·911
Calories of undetermined matter per grm. of solids	0·115	0·161	0·550	0·544	0·375	0·389	0·465	0·771
Calories per grm. of undetermined matter	2·725	3·684	4·443	4·060	4·112	4·035	4·159	4·600

It is thus seen that the calorific value of the undetermined organic matter is lowest in the cane juice (1) and highest in the residual molasses (3) and (8). In comparing the syrups which had been passed over char (4), (5), (6) and (7), with the two residual molasses, the removal of dehydration products is indicated by the lower calorific value of the organic non-sugars (as well as by its lighter colour). The carbon content of the organic constituents originating from the cane varies from about 36 per cent. in the case of aspartic acid to 60 per cent. or more in that of humoid decomposition products. The accumulation of gums, caramel, glucinic acid and its humoid decomposition products in low-grade molasses should cause the carbon content of the non-sugars in such molasses to be higher than in syrups made by sulphitation or bone-black filtration. Determinations of the carbon[1] upon the dried solids lead to the calculation of the following results :—

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[1] These calorific values are no doubt a little low in all cases, owing to the retention of water of crystallization by the constituents when drying at 70° C. The method of dry substance determination used was that described in *I.S.J.* 1919, 599.

	1	2	3	6	7	8
Total carbon in solids, per cent.	38·945	40·138	39·790	38·159	39·394	39·249
Carbon in sugars per cent., solids	37·752	38·376	33·826	34·210	34·615	31·037
Carbon in organic non-sugars per cent., solids	1·193	1·762	5·964	3·949	4·779	8·212
Carbon in non-sugars, per cent. non-sugars	28·27	40·32	48·17	40·97	42·74	49·00

It is thus seen that the carbon content of the organic non-sugars present the same relative order as that of the calories, being lowest in the cane juice and highest in the refinery molasses. The effect of char filtration in removing dehydration products by high carbon content is shown by comparing the low carbon contents of (6) or (7) with the high percentages of (3) and (8).

By-products of the Beet Factory, their Utilization as Cattle Fodder. *R. C. Kibby. Facts about Sugar, 1919, 9, No. 12, 230-231.*

In order to realize as great a profit as possible from the by-products of the beet factory, it is necessary to consider (1) how they can most economically be handled; (2) their actual value as food for live stock ; and (3) the amount of each to be fed to obtain the best returns. Each acre of beet yields approximately 0·5 ton of molasses ; 4·5 ton of green pulp ; and enough tops to make 3½ tons of silage. If the amount of total digestable nutrients contained in 100 lb. of corn be taken as 1, that in dry beet pulp is 0·87 ; in wet beet pulp, 0·09 ; in beet top silage, 0·21 ; in dry beet tops, 0·64 ; and in molasses 0·68. Beet tops, pulp, tails, and molasses in whatever form they may be are all laxative feeds, a property making them valuable components of a ration if used in moderation, but harmful if used in excess. In the following table is shown in a general way the maximum amounts of beet by-products (in lbs. per head per day) which ordinarily may profitably be included in a ration :—

	Beet Tops.		Pulp.			Tails,
	Siloed.	Dried.	Cured.	Dried.	Molasses.	Fresh.
Horses, mules, and colts	—	12	—	3	3	2
Fattening steers (1000 lbs. wt.)	40	20	100	10	4	40
Fattening cows (800 lbs. wt.)	32	16	80	8	3	32
Young cattle (600 lbs. wt.)	24	12	40	4	2	25
Fattening bulls (1200 lbs. wt.)	48	24	150	15	5	50
Dairy cows	30	15	60	6	3	25
Fattening sheep	6	3	10	1	3	4
Ewes, suckling lambs	6	3	10	1	—	4
Fattening hogs	—	3	—	2	1·5	3
Sows, sucking pigs	—	2	—	1	—	3
Dry sows, and shotes	—	3	3	5	—	3

Siloed tops keep soft and juicy, and serve as a succulent feed in winter, while being a carbohydrate ration they balance an alfalfa and cottonseed feed. They come out of the silo warm in winter (owing to the heat generated by fermentation), stimulate the assimilation of food, while the acids act as an appetizer, keep the digestive tract healthy and stimulate the flow of milk. Siloing softens the fibres, makes the proteins more digestible, and adds new flavours. Tops form an excellent feed for fattening steers, young cattle, dairy cows, sheep or lambs, but owing to their acidity would doubtless be harmful if fed to horses or dogs. Tops may be dried and stacked, when they are relished by all kinds of farm animals. Cured pulp is produced by keeping in pits for two or three years, and it is necessary gradually to accustom animals to eating it. Animals eating pulp drink more water, and this is an excellent milk producer. Dried pulp has a food value nearly equal to that of corn. Molasses is relished by almost any class of animals; and straw, bean straw, damaged hay, or almost any "roughage" is made palatable by its addition. It fattens horses for market very rapidly, though it is a soft fat. It should not be fed continuously to young pigs, and not at all to pregnant sows, ewes, cows, or mares, nor to young lambs, calves and colts. Lastly, regarding beet tails, this product is somewhat similar to whole beet as a feed, though generally it is mixed with alfalfa roots and beet leaves. It makes hogs grow rapidly, but is not very fattening. It may be siloed with the tops.

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[1] Made by J. A. Fries, of the Pennsylvania State College, who also determined the calorific values.

PAPER MAKING QUALITIES OF BAGASSE FROM HAWAIIAN MILLS. *A. D. Little, Inc.* *Report of the Experiment Station, Hawaiian Sugar Planters' Association, Bulletin No. 46.*

Both the plain caustic soda and the sulphate processes of preparing pulp from bagasse may be used, and there is little difference in the technical results between them. It was found that the best yields of bleached pulp were obtained from bagasse from the Yellow Caledonia cane, namely about 30 per cent. on the air dry material without shredding, and 48 per cent. when shredding by the Simmons process. As to the quality of the pulp, this was shown to be excellent for fine white papers, especially when blended with longer fibres In the preparation of the bagasse for pulping, the principal feature is the separation of the pith from the fibre by shredding, milling, and sifting in a rotary screen. This separation must be done before digestion, in order to save the consumption of chemicals by the valueless pith cells. A difficulty in the utilization of bagasse is the storage of the material in the "off" season, as the space for accumulating sufficient material for the remainder of the year during which the paper would be manufactured would require to be very large. This difficulty would be lessened by storing the pulp. It is stated that good results have been obtained in Cuba by the Simmons process.

DETERMINATION OF SUCROSE BY DIRECT POLARIZATION AFTER DESTRUCTION OF THE REDUCING SUGARS. *Alex Brodie.* *Paper presented at the 17th Annual Meeting of the Hawaiian Chemists' Association.*

On account of its simplicity, Mr. McALLEP recommended to the Committee on Analytical Methods that Muller's method [1] for the determination of sucrose in molasses and other products should be investigated. Five determinations have been made by Mr. L. L. LYNCH, of the Experiment Station, using molasses, and closely following the directions prescribed by MULLER, according to which it will be remembered the reducing sugars are oxidized by boiling with a solution somewhat resembling Fehling's, but containing a bismuth salt. In comparison with the results obtained by the method adopted by the Hawaiian Chemists' Association, the results were always lower by 1·13 to 2·46 per cent.[2] It was ascertained that the bismuth reagent does not attack the sucrose under the conditions prescribed. Results were obtained, however, indicating that the reducing sugars were not all destroyed. Using a solution of invert sugar of the same content as the reducing sugar of the molasses examined (10·2–20·3 per cent.), and adding the amount of bismuth reagent stated by MULLER, a reading of about -1·0° was obtained, even when heating was prolonged to twice the prescribed time. It would appear therefore that the incomplete destruction of the reducing sugars may explain the low results, though it must be borne in mind that recently Mr. BRODIE showed the Hawaiian Chemists' Association method to give results somewhat too high.

J. P. O.

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[1] *I.S.J.*, 1916, 274.

[2] *Ibid.*, 1919, 196.

Review of Recent Patents.[1]

UNITED STATES.

MACHINE FOR STRIPPING CANE PREVIOUS TO CRUSHING. *Micajah R. Davis.* *1,302,903.* Patented, May 6th, 1919. (Four figures).

Previous to being crushed, the cane is guided by means of suitably inclined boards between rapidly rotating rolls having short chains secured to their surface. Means are provided also for gathering and removing the separated leaves.

PREPARATION OF A DYE FROM FILTER-PRESS CAKES. *Hajime Nagashima*, of Formosa. *1,308,552.* Patented, July 1st, 1919.

A permanent dye stuff, it is claimed, may be prepared from the press mud obtained in sugar factories by dissolving out the lime and by treating the residue with caustic alkali and sulphur (or with an alkali polysulphide), the details of the method given by the inventor being as follows: Filter-press cake is kneaded with water into a homogeneous paste, and just sufficient nitric or hydrochloric acid (preferably the former), added to dissolve out all the lime present, the temperature being raised to boiling point. This mass is washed to eliminate most of the acid, using a bag of linen or cotton. Flowers of sulphur and caustic soda (the proportions of which are not given) are mixed with the paste, which is dried in a flat pan, while stirring, a granular product thus being obtained. This is powdered, and heated sufficiently to volatilize the excess of sulphur. Alternatively, after extracting the lime by acid from the cake, and washing with water, flowers of sulphur may be added, followed by the caustic alkali after drying. Or again, the alkali may be added first and the sulphur afterwards. It is stated that the presence of calcium sulphide is very injurious to the colour; but that by following the process outlined a very high yield of a permanent dye may economically be obtained.

RECOVERY OF POTASH SALTS AND NITRATES FROM STEFFEN'S WASTE WATER. *Martin J. Kermer and Henry A. Faber.* *1,303,916.* Patented, May 20th, 1919. (One figure).

Steffen's waste water is heated to 185° F. (85° C.), to form a precipitate of what is technically known as "hot saccharate." It is filtered, and its alkalinity reduced by treatment with carbon dioxide until it contains about 0 1 grm. calcium oxide (CaO.) per 100 c.c. Sulphuric acid in sufficient amount to convert the salts (principally those of potassium) into sulphates, and the liquor evaporated until the potassium sulphate crystallizes out. After separating this compound, the remaining solution (which contains nitrates) is concentrated to dryness, having a certain commercial value.

CLARIFICATION OF RAW JUICES BY FILTRATION WITH KIESELGUHR. *Philip L. Wooster.* *1,304,438.* Patented, May 30th, 1919.

It has been discovered by the inventor that "in spite of the universal practice, a proper purification of the raw juice or liquor may be effected without the use of lime and sulphurous acid." Juice as it comes from the mills is treated with a small quantity of kieselguhr, and passed directly through a filter-press, the albumen and other suspended matter being held mechanically by the diatomaceous matter. On the other hand, when lime has been used, and it is attempted to pass the tempered juice through cloth, the precipitated bodies immediately clog the pores. It is claimed that by the use of kieselguhr alone in this way, a purer and lighter juice results than when lime is employed.

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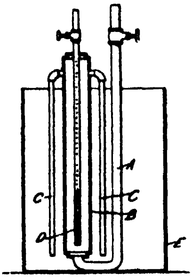
[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sale Branch, 25, Southampton Buildings, Chancery Lane, London, W.C. (price, 8d. each). *United States:* Commissioner of Patents, Washington, D C. (price 5 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 1 fr. 05 c. each).

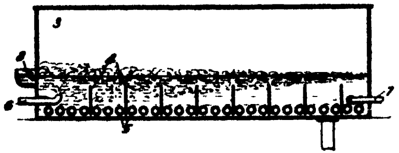
Purifying Cane and Beet Juices and Syrups using Decolorizing Carbon. *Russell W. Mumford,* (Assignor to *Refining Products Corporation).* *1,314,203.* Patented, August 26th 1919.

In applying the decolorizing carbon the preparation of which has already been described,[1] claim is made for a process of working, in which the juice is defecated, concentrated to syrup, mixed with the preparation during 10-15 minutes with constant agitation (using a stirrer or an air blast), and passed through a filter-press, being subsequently boiled to grain. It is possible to use the carbon at other stages, *e.g.*, previous to concentration to syrup, or previous to defecating the juice, but treatment at the syrup stage is preferable. The carbon acts effectively on cold or neutral solutions ; it is not essential to acidity the liquor, though it may be acidified and heated to 80-90 C. if deemed advisable. Revivification is effected by boiling with a weak solution of sodium hydroxide (2-10 per cent.), finally washing with dilute hydrochloric acid to remove alkali.

Clarification of Juices or Syrups, using Aeration. *George B. Williamson.* *1,317,607.* Patented, September 30th, 1919. (Two figures.)

Clarification of the juice or syrup is previously effected in some suitable manner, after which air is forced through it, using the apparatus shown in the upper figure.[2] In the case of juice, this clarification may be effected by lime alone, or by lime followed by phosphoric or sulphurous acid. Raw sugar may be affined by washing in centrifugals, and the resulting crystals melted with 50 per cent. of their weight of water, this syrup being treated with lime and phosphoric acid, or alternatively with phosphoric acid and lime. The raw sugar washings may be treated in the same manner. Whichever mode of clarification be adopted, the liquid is delivered through a pipe *A* to the bottom of a chamber *B*, which has an overflow *C* at the top. An air line is provided in chamber *B*, which is preferably long and narrow, so that the line *D* extending along the entire length can aerate all the liquid present in it. Conduit *D* is therefore perforated ; and the overflow conduit *C* preferably enters a receiving tank *E* in which the air chamber *B* may be located.





Following the aeration, the liquid is fed to the tank *3* shown in the lower figure, which has a series of partitions or baffles *4* dividing the space into compartments, each being provided with steam pipes *5* located near the bottom. The partitions *4* are spaced from the bottom of the tank. Steam is fed to the pipes from both sides of the tank so that the alternate pipes receive the steam from opposite sides of the tank ; thereby maintaining a more uniform temperature within the defecating tank. In this way the temperature of the solution is raised to about 210° F. The precipitant carries away with it suspended impurities, which with the air are carried to the surface and form a layer of scum at the top, leaving a clear solution at the bottom in about ten minutes. Having effected the separation, the steam is lowered ; and the inlet *6* and outlet *7* from the tank *4* opened to cause a continuous flow of the solution, which may be regulated to maintain the same temperature in the tank. The baffle plates serve as a guide for the impurities, to direct them toward the top where they are entangled with the albumenoids and discharged through a special overflow *8* provided in the tank. This method of clarification is stated to be efficient, rapid and economical, while also easy of operation.

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[1] *I.S.J.*, 1919, 357.

[2] Some particulars regarding it have already been published : see *I.S.J.*, 1919, 525.

Cooling and Conveying Animal Charcoal (Bone-Black). ***Mirabeau Sims***, of Llanerch, Pa., U.S.A. *1,300,784*. Patented, April 15th, 1919. (Five figures.)

Char as it issued from the kilns has a temperature of about 400° F. (204° C.), which must be reduced to about 120° F. (49° C.) before being returned to the cisterns. In common practice, it is dropped from the kiln at intervals in a stream about 3 in. in diam., which runs for about 6 seconds and is interrupted for about 12 seconds, this operation proceeding continuously. According to the present invention, the kilns are adopted to deliver to hoppers arranged along a horizontal pneumatic conveying pipe. At the bottom of each hopper are double sliding gates, which are adjustable to allow the proper flow of material through a screen consisting of a series of perforations in the wall of the pipe enclosed by the hopper. A further cooling takes place as the char encounters the air drawn through the conveying pipe, and again as it is discharged upon the belt conveying it to the cisterns

Lining for Centrifugals. ***Edward D. Mackintosh (Assignor to S. S. Hepworth Co.)***, of New York, U.S.A. *1,313,227*. Patented, August 12th, 1919. (Two figures.)

In using two foraminous linings within the basket of a centrifugal machine, one lies against the perforated cylindrical wall of the basket and permits the liquid which passes through it to travel along the surface of the wall to reach the perforations; while the other lies against the first and acts as a sieve. Usually the first is a piece of coarse wire cloth, and the other a thin perforated plate. These are not secured to each other and, unless fastened to the basket in some way, are liable to collapse. As there are objections to fastening the linings to the basket they are fastened to each other near one end, preferably through the medium of a separating strip and the other end of the inner lining is tucked between the two, thus accomplishing the support of the linings against collapse. The two are best fastened together by means of solder.

Cane Mill having Rollers with Resiliently Mounted Pins for the Increase of the Gripping Capacity. ***Abraham M. Erkelens***, of Soerabaja, Java. *1,283,123*. Application filed, December 23rd, 1915; patented, October 29th, 1918. (Four figures.) See United Kingdom Patent, 12,265; applied for, August 25th, 1915[1].

Centrifugals. (1) ***Philip T. Sharples***. *1,320,419*. Patented, November 4th, 1919. (2) ***Edward D. Mackintosh***. *1,321,766-1,321,767*. Patented, November 11th, 1919. (3) ***George M. Bacon***. *1,321,353,-1,321,354*. Patented, November, 11th, 1919.

Centrifugal for Clarifying Rice. ***Roque Galguera y Gonzalez***, of Cuba. *1,292,758*. Patented, January 28th, 1919. (Four figures.)

Gyratory Shaft Hanger for Suspended Centrifugals. ***Harry R. Stephens***, *1,302,872*. Patented, May 6th, 1919. (One figure.)

UNITED KINGDOM.

Production of an Edible Product from Beet. ***Paul Kestner***. *135,235 (14,969)*. Application date, September 14th, 1918; complete accepted, November 27th, 1919.

Claim is made for a process of manufacturing a sweet extract from beet, consisting in treating the extracted juice in an evaporator in which the temperature is raised by setting up a counter pressure, and the concentration carried out in a very short time. An improved food product free from any unpleasant odour or flavour is obtained by this process, the essentials of which are rapidity of treatment and high temperature. If the desired concentration of the syrup be such that its boiling point would be 120° C., such a counter pressure is provided that the boiling point is raised to 130° C. (more or less); but the syrup must not be maintained at this degree more than a few seconds. Preferably the Kestner type of evaporator is used. As the steam evolved is above atmospheric pressure, it may be profitably employed for drying beet pulp or other material in the factory.

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[1] *I S J.*, 1917, 286.

DECOLORIZING CARBON, PREPARED BY HEATING A MIXTURE OF VEGETABLE MATTER, COLLOID MATERIAL, AND MINERAL SPACING AGENT. *Russell W. Mumford*, of Baltimore, U.S.A. *133,759* (*16,757*). Date of application, October 14th, 1918; complete accepted, October 14th, 1919.

A vegetable decolorizing carbon stated to be of great power and rapidity of action is prepared by slowly heating an intimate mixture of moist vegetable matter (sawdust, peat, lignite, bark, maize cobs, etc.), colloid material (solution of gelatin, potato or rice flour, starch and gluten, clay, hydrated silicates, etc.), and mineral spacing agent (as dolomite, manganese dioxide, magnesium carbonate and phosphatic rock). In an example of the process, the vegetable matter is comminuted, washed with hot water, mixed with gelatinous tricalcium phosphate or boiled with potato flour or starch so as to form a paste, and finally mixed with finely powdered dolomite. This mass is heated in a retort which can be slowly rotated when the temperature remains for some time at 100° C. until all the water is expelled and the colloid is set, after which it rises slowly until at 250° C. the mass is completely charred. Then the temperature is raised to decompose the dolomite which evolves carbon dioxide, and this continues until 800° to 900° C. is reached; the material is dumped into water with the exclusion of air, and the product freed from mineral matters either by subsiding or centrifuging, or by treatment with an acid. Lastly, the product is dried and, if desired, ground. In order to control the temperature during the charring process, it is convenient to use a reverberatory furnace heated on the surface combustion principle, the material to be charred being spread in relatively thin layers in metal trays which are placed on the sole or hearth of the furnace. Usually it is detrimental to the product to conduct the charring in the presence of steam or products of combustion from any other source, since these cause the carbon to waste away; but in the case of material of less open texture such as lignite or brown coal, the introduction of steam is in certain cases advantageous. After use, the carbon can be revivified by treatment with hydrochloric acid alone, or by washing first with hot water, then with caustic soda solution, again with hot water, and finally with hydrochloric acid. After drying, it is ready for re-use, and heating in retorts is unnecessary.[1]

SUBSTITUTE FOR JAM, PRESERVE, OR JELLY. *Raymond de Ridder*. of London. *133,767* (*16,834*). Application date, October 15th, 1918; complete accepted, October 15th, 1919.

It consists of flour, 100 parts; flavouring essence in powder, 12·5; colouring matter, 6·3; tartaric acid, 0·1; and common salt, 0·2. This mixture (which may be sold in small packets), is mixed to a paste with cold water, boiled, sweetened, and cooled. It may be used as such as a substitute, or may be mixed with jam or jelly, in order to supplement the ration.

EVAPORATION OF JUICE OR SYRUP BY PASSAGE THROUGH A HEATED SPIRAL. *Edward Shaw*. *129,584* (*3238* of *1919*). Application date, February 10th, 1619; complete accepted, July 17th, 1919. (One figure).

In using the apparatus previously described,[2] it has been found that, although it works perfectly with some solutions, certain viscous liquids prefer to travel along the horizontal platform with the steam moving along the spiral passage at the top. In the present patent, claim is made for the improvement consisting in sloping the spiral shelf or plate downward to an angle of 30 to 60°, but preferably about 45°, according to the nature of the liquid under treatment. This modification causes the liquid to travel downward through the spiral passage against the outer heated tube.

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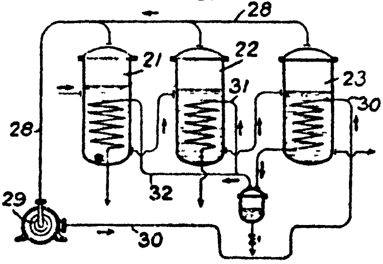
[1] Compare also, *I. S. J.*, 1919, 357.

[2] U. K. Patent, 13, 602 of 1914; *I. S. J.*, 1914, 485. See also *I. S. J.*, 1915, 148 and 290.

Evaporation with Vapour Compression. *Paul E. Matter*, of Aarau, Switzerland. *124,732 (6640)*. Application date, March 17th, 1919; complete accepted, August 28th, 1919; convention date (Switzerland), March 26th, 1918. (Two figures).

A process of evaporation is described, in which the vapour given off by the liquid under concentration is withdrawn, compressed, and used again for heating, the method being characterized by the feature that the vapour coming from the compressor is brought into heat exchange, first with the most highly concentrated portion of the liquid, and later with the remainder. Referring to the drawing it is seen that the concentrating vessels *21*, *22* and *23* are connected together in series for the circulation of the liquid to be concentrated, which passes successively through the vessels *21*, *22* and *23*. The vapour given off from the three vessels is sucked through the collecting pipe *28* by the compressor *29*, is compressed by the latter, and is delivered through the pipe *30* into the last vessel *23*. In the latter the heating vapour gives up a portion of its heat. If the vapour was initially in a superheated condition in the pipe *30*, due to the previous compression, the degree of superheat diminishes as the vapour flows through the heating space contained in the vessel *23*, so that the vapour passing out from this vessel is either only slightly superheated, or is already saturated. From the heating space of the vessel *23*, half of the heating vapour passes through the pipe *31* into the heating space of the evaporating vessel *22*; the other half passes through the pipe *32* itno the heating space of the evaporating vessel *21*. In this vessel the heating vapour is completely condensed; the liquid of condensation flows out of the heating spaces of the vessels *22* and *21* through the pipes *33* and *34*. After leaving the heating space of the evaporating vessel *23*, the vapour can be passed through a steam trap before entering the heating chambers of the vessels *22* and *21*.

FIG.2.



Machine for Forming or Decorating Confectionery. *Asbjörn Sonsthagen*, of West Ealing, London. *133,424* (*16,282*). Date of application, October 7th, 1918; complete accepted, 7th October, 1919. (Nine figures.)

Evaporation with Compression of the Vapours Produced. *Einar Morterud*, of Norway. (1) *120,205* (*15,961*). Application date. October 1st, 1918; complete accepted, October 1st, 1919. (Three figures.) (2) *126,565* (*15,960*). Application date, October 1st, 1918; complete accepted, May 15th, 1919. (3) *132,893* (*15,959*), Application date, October 1st, 1918; complete accepted, October 1st, 1919.

Moulds for making Sweetmeats. *W. P. Douglas*. *132,366* (*15,196*). Date of application, September 18th, 1918, complete accepted, November 5th, 1919.

Cocoa-Butter Presses. *J. Baker & Sons, and W. E. Prescott*. *133,426* (*16,319*). Date of application, October 7th, 1918; complete accepted, October 7th, 1919.

Manufacture of an Edible Syrup from Beets. *Henry S. Alexander*, of London. *133,744* (*16,607*). Application date, October 11th, 1918; ccomplete accepted October 13th, 1919.

After washing, the roots are "cooked" in such a manner that the protein and pectine, substances are partially coagulated, the juice caramelized to some extent, and conversion of a portion of the sucrose is effected. This is preferably accomplished by subjecting the roots to the action of steam in an autoclave at a pressure of about three kilos. per sq. in. and a temperature of 110—130° C. during ¾—1½ hours, the water formed by condensation being drained off. Subsequently, the juice is extracted from the pulp in presses, and the liquid obtained evaporated to a syrup of 38 Bé. in a multiple effect or vacuum pan. It is stated that the product has not the characteristic flavour or smell of beetroot.

Preparation of Vegetable Decolorizing Carbon without the Use of "Impregnating Substances." *Charles E. Eastick and Samuel P. Eastick.* *136,873* (*20,971*). Date of application, December 16th, 1918; complete accepted, December 16th, 1919.

Hitherto decolorizing carbon has been made from sawdust and other carbonaceous matter after previously impregnating with such substances as calcium acetate, magnesium or zinc salts, but after carbonizing, these or their resultant compounds had to be removed by washing with acids or other solvents. It has also been proposed to use wood sawdust, peat, or the like moistened with a solution of potato starch, or mixed with finely chopped potatoes or raw sliced beets. The inventors, however, have discovered that, providing the vegetable matter is first reduced to a very small or fine powdery condition, this preliminary treatment of the vegetable matter prior to carbonization is quite unnecessary, the cost of the preliminary treatment thus being eliminated. For example, vegetable matter, such as wood pulp ground to a fine powder, or what is known in commerce as chemical wood pulp, can be used, or wood sawdust, or chips of wood, or ordinary charcoal, "or any other suitable vegetable matter after being ground or reduced to a powder." Any of these materials after being soaked in water can be carbonized at a red to white heat in a suitable vessel from which air is excluded during carbonization, when the resultant carbon will be found to possess a powerful decolorizing effect. This power may further be increased by the removal of any of the ash that may exist in the carbon by washing with a suitable acid, such as hydrochloric.

UNITED KINGDOM COMPLETE SPECIFICATIONS ACCEPTED.[1]

Fertilizer. *P. Radmann.* *137,171* (*5477*). March 5th, 1919.

Installation for Confectionery Factories. *D. M. Stewart.* *127,263* (*21,708*). September 4th, 1919.

Production of Caramel. *A. Daniel.* *137,339* (*16,678*). November 13th, 1917.

Cane Mills. *J. Wilson.* *137,357* (*21,879*). December 31st, 1918.

Centrifugals. *C. A. Fesca & Sohn.* *137,827* (*978*). June 26th, 1918.

Manufacture of Cellulose. *C. A. Braun.* *137,831* (*999*). August 5th, 1916.

Purification of Syrups and After-Products. *M. von Wierusz-Kowalski.* *137,849* (*1247*). April 21st, 1915.

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[1] The date given is that of application.

Sugar Crops of the World.

(Willett & Gray's Estimates of Crops to January 15th, 1920.)

	Harvesting Period.	1919-20. Tons.	1918-19. Tons.	1917-18. Tons.
United States—Louisiana	Oct.-Jan.	103,202	250,802	217,499
Texas	,, ,,	2,000	3,125	2,009
Porto Rico	Jan.-June	426,631	362,618	413,958
Hawaiian Islands	Nov.-July	500,000	535,000	515,035
West Indies—Virgin Islands	Jan.-June	12,000	9,000	5,400
Cuba	Dec.-June	4,300,000	3,971,776	3,446,083
British West Indies—Trinidad	Jan.-June	65,000	47,850	45,256
Barbados	,, ,,	70,000	80,000	65,230
Jamaica	,, ,,	50,000	40,000	34,300
Antigua	Feb.-July	12,000	10,000	9,409
St. Kitts	Feb.-Aug.	11,000	9,300	8,846
Other British West Indies	Jan.-June	10,000	10,000	16,745
French West Indies—Martinique	Jan.-July	22,000	30,000	20,881
Guadeloupe	,, ,,	31,000	25,000	28,000
San Domingo	Jan.-June	180,000	158,309	127,322
Haiti	Dec.-June	5,000	3,300	....
Mexico	,, ,,	85,000	60,000	40,000
Central America	Jan.-June	30,000	30,000	25,000
South America—				
Demerara	Oct.-Dec. and May-June	90,000	107,560	108,181
Surinam	Oct.-Jan.	12,000	8,000	9,739
Venezuela, *exports*	Oct.-Dec.	18,000	15,000	15,000
Ecuador	Oct.-Feb.	7,000	7,000	8,000
Peru	,, ,,	250,000	250,000	265,000
Argentina	May-Nov.	250,000	130,266	87,699
Brazil	Oct.-Feb.	187,000	183,079	148,958
Total in America		6,728,833	6,336,985	5,663,550
Asia—Brit. India (consumed locally)	Dec.-May	2,800,000	2,337,000	3,311,000
Java (1920-21, 1,500,000)	May-Nov.	1,335,763	1,749,408	1,778,345
Formosa and Japan	Nov.-June	300,000	415,678	397,618
Philippine Islands	,, ,,	225,000	192,000	216,260
Total in Asia		4,660,763	4,694,086	5,703,223
Australia	June-Nov.	175,000	226,000	325,900
Fiji Islands	,, ,,	60,000	80,000	70,800
Total in Australia and Polynesia		235,000	306,000	396,700
Africa—Egypt (consumed locally)	Jan.-June	90,000	82,000	79,450
Mauritius	Aug.-Jan.	242,000	278,555	249,000
Réunion	,, ,,	50,000	50,000	50,000
Natal	May-Oct.	150,000	144,000	106,250
Mozambique	,, ,,	50,000	50,000	50,000
Total in Africa		582,000	604,555	534,700
Europe—Spain	Dec.-June	6,000	6,618	7,039
Total cane sugar crops		12,212,596	11,948,244	12,305,212
Europe—Beet sugar crops		2,894,000	3,697,499	4,291,206
United States—Beet sugar crop	July-Jan.	700,000	674,892	682,867
Canada—Beet sugar crop	Oct.-Dec.	20,000	22,300	11,250
Grand total Cane and Beet Sugar	**Tons**	**15,826,596**	**16,342,935**	**17,290,535**
Estimated decrease in the world's production	**,,**	**516,339**	**....**	**....**

United States.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1920 Tons.	1919. Tons.
Total Receipts January 1st to 15th	81,206	40,554
Receipts of Refined ,, ,,	—	—
Deliveries ,, ,,	81,206	40,554
Importers' Stocks, January 14th	—	—
Total Stocks, January 14th	35,638	18,044
Stocks in Cuba, January 14th	34,831	177,501
	1919.	1918.
Total Consumption for twelve months	4,067,671	3,495,606

Beet Crops of Europe.

(Willett & Gray's Estimates to January 15th, 1920.)

	Harvesting Period.	1919-20. Tons	1918-19. Tons.	1917-18. Tons.
Germany	Sept.-Jan.	750,000	1,411,900	1,541,061
Czecho-Slovakia, Hungary and Austria	Sept.-Jan.	700,000	700,000	668,250
France	Sept.-Jan.	170,000	110,096	200,265
Belgium	Sept -Jan.	125,000	75,000	131,000
Holland	Sept.-Jan.	200,000	173,436	199,295
Russia (Ukraine, Poland, etc.)	Sept.-Jan.	350,000	700,000	1,028,580
Sweden	Sept.-Jan.	150,000	127,467	125,000
Denmark	Sept.-Jan.	160,000	144,600	136,800
Italy	Sept.-Jan.	150,000	100,000	100,000
Spain	Sept.-Jan.	120,000	135,000	134,955
Switzerland	Sept.-Jan.	4,000	4,000	4,000
Bulgaria	Sept.-Jan.	15,000	16,000	22,000
		2,894,000	3,697,499	4,291,206

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR ONE MONTH ENDING JANUARY 31ST, 1913, 1919, 1920.

	IMPORTS.			EXPORTS (Foreign).		
	1913. Tons.	1919. Tons.	1920. Tons.	1913. Tons.	1919. Tons.	1920 Tons.
Refined	78,597	12,791	45,902	78	—	230
Raw	77,941	70,208	55,780	234	19	1,223
Molasses	83,500	2,370	6,928	61	7	387
	240,038	85,369	108,610	373	26	1,840

	HOME CONSUMPTION.		
	1913. Tons.	1919. Tons.	1920. Tons.
Refined	74,503	6,491	33,582
Refined (in Bond) in the United Kingdom	59,431	67,663	57,451
Raw	9,479	15,092	20,960
Molasses	3,019	1,982	5,047
Molasses, manufactured (in Bond) in United Kingdom	3,313	6,497	6,374
Total	149,745	97,725	123,414
Less Exports of British Refined	2,109	106	30
	147,636	97,619	123,384

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Notes and Comments.

Politics at Home.

The political event of the last few weeks has been the return to the House of Commons of Mr. Asquith after a very successful by-election. His reappearance in politics has been welcomed not only by his attenuated following in Parliament but also by many public men of all creeds and political views. But the welcome has in the aggregate been accorded him not because of any desire for a resuscitation of Asquithian Government but solely because a strong Opposition Leader is needed in Parliament to ensure that the country gets its full meed of constitutional government, and for that purpose Mr. Asquith undoubtedly stands head and shoulders above his contemporaries of the Liberal persuasion. This being in all probability the real reason for his successful re-entry into the arena, it is somewhat premature to suppose as some prophets have opined that it is the first stage towards bringing into power once more a Liberal Government, such as existed down to the outbreak of the great war.

We are not concerned here to discuss home politics in their general aspect; but it will always be a matter for concern to us as to the attitude of a given political party towards the British sugar industry, especially since the policy of Imperial Preference was established last summer. The independent Liberals, whom Mr. Asquith is now to lead, were the most resolute opposers of the proposal to accord the British Empire preference on entry into the markets of the United Kingdom; they trotted out all the old stock arguments, which were in substance a passionate subscription to the sacred and unchangeable principles of free trade to which they and their fathers before them had sworn allegiance under very different circumstances to those ruling to-day. There were, it is true, Liberals like Sir Alfred Mond who actually justified the Preference proposals in the light of free trade, but we fear that the bulk of the Asquithian Liberals are as determined as ever to maintain their old arm-chair theories, never mind what the lessons of the recent war have been. If that be so, then one could only view with disquietude the prospect of their re-entry into Government, as we think nothing would be so disturbing to Imperial industry and trade as periodical reverses of policy. Fortunately, it does not seem likely that the Liberal party are destined at any early date to return to power, even though it may prove the case that they are not yet the lost cause that a short while ago public opinion in general seemed inclined to suppose.

It is more likely that when we get a Government which does not consist of the cadres of the present Coalition, it will be a Labour one. That being so, it is of some moment to consider what the attitude of labour leaders is towards Imperial problems. Some of the more enlightened men, such as Mr. CLYNES and Mr. ROBERTS, have served in the present Government as Food Controllers, and in that position have had much valuable experience of the need to develop the Imperial resources of food supply. Mr. ROBERTS has been made aware the last few months of the undesirability of our sugar supplies being so largely obtained at a high price from foreign sources, and he is a keen advocate of sugar beet cultivation in this country as a means of augmenting our supplies of sugar; but he has also expressed himself lately as believing in the development of the Empire as a whole. If such views were likely to prevail amongst the leaders of the Labour Party, one could face with some equanimity their accession to office one day. But while so many extremists with very narrow outlook continue to pose as leaders of labour in this country, the electors will do well to defer granting them the constitutional means to wreck the Empire, till they have learnt what the Empire really implies.

The Sugar Supply at Home.

No announcement has yet been made by the Royal Commission on the Sugar Supply as to their recent operations in the sugar market following on the decision of the American Equalization Board not to participate in buying the available supplies; but we have no reason to doubt that they are in process of securing the necessary supplies to make up the 1,100,000 odd tons required by this country under the restricted rationing during the current year. What is more, if they secure this quota at an early date we see no reason why they should not succeed further in obtaining at least a slight surplus, in which event it should be found possible to restore the ration to at least half a pound per head. The price is another matter, but even there it will probably be found that the Royal Commission have not done badly having regard to the prices that have been ruling on the world's market. Quotations of 16 cents have been made in Cuba recently which if free sugar were still allowed entry into the United Kingdom would mean about 135s. landed and duty paid in this country. What business is still being done in free sugars here under licence or for re-sale is being restricted by the Royal Commission to a maximum price of 120s. during the current month.

The public have been warned since before Christmas that the retail price of sugar would go up before long; towards the end of February it was intimated that the price of cubes was to be raised to 10¾d. (with other sorts pro rata), but at the time of writing the price fixed last November of 8¾d. is still in force. Meanwhile semi-official hints have been made that ultimately 1s. will be more like the ruling price. One must suppose that all these warnings and forecasts are an endeavour to break it gently to the public that they are not paying an economic price for their sugar. The rise to 1s. cannot be much longer delayed if the State sugar trade is not to be subsidized. One can only wonder whether the six and a half millions sterling surplus the Royal Commission had made down to March 1918 has yet been wiped out by subsequent sales at a loss. Its disappearance should certainly have been expedited by the somewhat remarkable decision of the Royal Commission to continue supplying sugar to jam manufacturers even down to this month at the low price of 66s. per cwt. (other manufacturers having to pay the more natural price of 110s.) On what grounds this continued subsidy of the jam makers is justified it is hard to say. It has certainly not been explained so far.

Dock congestion has lately been a controversial topic in the papers and in Parliament, and the sugar stocks are involved amongst others. Possibly it was due to a wish to release them and make the public their own storers that the Royal Commission before February was out suddenly sprung on the fruit-preserving public the decision that they must apply for their preserving sugar before March 11th if they wanted any this summer and autumn. Otherwise it would surely have been more reasonable to wait and see what the fruit crops were going to be.

Per Capita Consumption.

We saw it suggested in a leading daily newspaper that the per capita consumption in the United Kingdom in spite of the shortage of sugar was still higher than that of any other country of the world. Actually, however, the United Kingdom is greatly surpassed by the United States, which latter since they became "dry" have easily exceeded all records. As our American correspondent shows on page 128, their per capita consumption for 1919 on a population of 105 millions works out at 87·6 lbs., being an increase of no less than 14 lbs. as compared with 1918. But even that high figure is expected to be exceeded in 1920 since it is calculated that the United States may this year consume as much as 4,500,000 tons providing they can get it. This works out at 96 lbs. per head, or higher than the British pre-war figure which exceeded 90 lbs. (*e.g.* 91·68 in 1911). The highest pre-war consumer was however New Zealand with 130 lbs.

In the United Kingdom the consumption of sugar during 1919 amounted, according to the Board of Trade figures, to 1,649,645 tons. That figure includes 45,937 tons of imported molasses which cannot be classed as "consumption." So one must take the net figure as 1,603,708 tons; this distributed amongst a population of 46,005,000 (the latest official estimate of the population of the British Isles) works out at 78 lbs. per head or 9·6 lbs. less than the United States figure. In 1918 the figure was 50 lbs., and it may be remarked that the 1920 per capita allowance will be little if any higher than that of 1918 unless the Royal Commission do better than they anticipate in the matter of securing sugar supplies.

If the above figures prove correct, then it would appear that during 1920 the United States may have anything up to 45 lbs. per head more of sugar than the United Kingdom consumers.

A Tropical Agricultural College for the West Indies.

We are glad to see that the need for a British Tropical Agricultural College in our Colonies, for which we made a strong plea last summer,[1] has been fully recognized by a Government Committee which sat during the Autumn to consider the matter. This Committee, which was representative of tropical science as well as of various West Indian interests, has just issued its Report (summarized elsewhere); it comes to the unanimous conclusion that a tropical agricultural college is needed in the West Indies to give adequate instruction in the principles of agriculture of tropical produce of every kind, especially sugar and its by-products. The committee rightly recognize the excellent work that has been done by American agricultural colleges, especially the sugar school at Audubon Park, and they think the time has come for the British Empire to have at least one similar institution.

As will be seen elsewhere, it is recommended that both elementary and advanced instruction should be given by the teaching staff of the proposed college, and that post-graduate study in special tropical subjects should be offered to graduates of an approved University. This is only following the practice adopted at Audubon Park, of which we gave an outline some months ago.[2] Moreover a special sugar school attached to the college is advocated, where practical instruction in sugar manufacture can be given, from the grinding of the cane to the production of the finished sugar. This, we need hardly interpolate, was the point we most strongly urged when we advocated a tropical school as against special training at some home University. The latter serves a useful purpose and may continue to do so, but the advantages of a practical (if not also a theoretical) training at a college situated within the industry itself are too patent to be ignored and it was a foregone conclusion that the Committee would advocate the establishment of such a school in the West Indies itself.

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[1] *I. S. J.*, 1919, 157. [2] *Ibid*, 1919, 444.

The only point for regret in our opinion is the decision that, subject to proper support from the local government, the most advantageous position for the college is Trinidad. True this island is the "centre" of the sugar region which includes British Guiana on one side and the Lesser Antilles on the other. But Jamaica has strong claims; it has a population approximating to that of the rest of the British West Indies, and though it once forsook sugar in favour of fruit (at a time when the outlook for sugar was extremely dark and unpromising), it has returned to its old love with an enthusiasm which promises to develop an expansion such as neither Trinidad nor British Guiana will equal. Although on paper British Guiana comes easily first in the matter of possible increased output of sugar, there are a good many "ifs" that will have to be settled first, and meantime we think Jamaica may take the lead as the most progressive sugar-producing centre in the British West Indies. One proof of this is surely patent in the offer of the Jamaica Imperial Association to find £50,000 for erecting the college and £5000 per annum for its expenses if the venue of the college and of the Imperial Department of Agriculture is situated in Jamaica. This offer the Committee could not for the time being accept, but they hinted that if the Trinidad district did not support adequately the proposals for the college, the Jamaica offer might be considered again.

The obstacle to the selection of Jamaica would appear to be chiefly geographical. This island is situated at a considerable distance from the other West Indian sugar islands, and the facilities for intercolonial steamship communication do not appear to be adequate enough to ensure speedy travel. At any rate, we must surmise, that is the conclusion the Committee drew, and with Sir OWEN PHILIPPS a member of the body, the Committee must have had first hand evidence of what the transit outlook offered. But one would have thought that with Jamaica on the direct route to the Panama Canal, there were big possibilities of greater intercolonial traffic radiating from Kingston. The only alternative for Jamaica is apparently to have a local agricultural school of her own; but this implies the dividing up of the teaching talent between two colleges, and it has yet to be seen whether the West Indies can support two establishments to start with. If not, then the Jamaican students will have to make their way as best they can to Trinidad. Were it only a case of getting the students to and from college, the difference between Trinidad and Jamaica would probably not affect greatly one way or the other the transit difficulty; but the crux of the matter appears to be that the college will be closely connected with the Imperial Department of Agriculture, the Imperial Commissioner being destined to act as principal of the college, and as he has to tour the sugar islands at odd times and seasons, he is reluctant to be based on a centre which is at present for travelling purposes no centre at all.

However, it remains to be seen whether the enthusiasm of Jamaica, evidenced in their generous financial offer, will end in their getting a college even if it be not the one carried out under the auspices of the Imperial Department of Agriculture. If the money is forthcoming, much can be achieved even in a local training establishment. But, for the present, we have to await the decision of the Colonial Office in the matter, and it also remains to be seen whether Trinidad will through its Government afford "adequate support and every reasonable facility" for making the proposed college a success. In any event it seems fairly certain that the recommendations of the Committee will be translated into action before very long.

A British Refiner's Complaint.

In *Production* for February, W. H. GIFFARD, secretary to the British Empire Sugar Research Association usefully collates some of the views that have been advanced lately in criticism of the operations of the Royal Commission for the Sugar Supply. Apart from a statement originally issued to the Press by Mr. SANDBACH PARKER (in which he accused the Royal Commission of shortsightedness in not buying more largely last Autumn when prices of sugar were lower and thereby obviating the necessity to reduce the ration of this country in a vain attempt to beat down the price), the most pertinent criticism is that of Mr. KERR, the well-known Greenock refiner, who complains that the Royal Commission during 1919 allowed 500,000 tons of raw Cuban sugar to be refined in the United States, thus giving employment to American labour and capital in the process. "One would naturally have thought (said Mr. KERR) that the British Government as represented by the Royal Commission would have tried to do something for the *home* refiner, but they seem to leave him alone to make merely his pre-war profit while the American is given a very large proportion of this country's requirements to manufacture on a toll basis which, from our knowledge of the American, I should think will return him a very handsome profit. It would be very interesting to know what his allowance of profit was compared with the miserable 4d. per cwt. which is the amount allowed to several at all events of our home refiners; a sum which, with labour, machinery, and buildings at the price they are either reduces his 4d. to very little or, in one case at any rate, to an actual loss. That is, unless he is lazy and unprogressive—and this is one of the anomalies of the present way of working, for if he does not extend he can put his money in his pocket, but the moment he tries to increase his output and therefore the output of this country, and gives this country more sugar and employs more labour, then he is out of pocket. Another nice commentary on Government control of industry!"

Whoever was responsible for this decision, whether it was part of the bargain struck with the American Equalization Board whereby the United Kingdom was to secure one-third of the 1918-19 Cuban crop, or whether it was due to official incompetence to ascertain properly the ability of the British refining houses to tackle the half millon tons on their own, it will be agreed that it would be hard to justify the official decision to let a third party refine Cuban sugar destined for the British market, all the more as with the exchange so much against us something would have been saved by refining the sugar within the United Kingdom. However we do not suppose that this arrangement at the expense of home industry has been an isolated instance; plenty of other industries might with equal force complain of the effects of state-control during the last few years. Certainly it has to be admitted that the Royal Commission have done pretty well on the whole in stabilizing sugar prices for this country, and doubtless their failure to purchase sugar last Autumn was due more to legitimate misjudgment of political probabilities than to any official shortsightedness. But their omission to secure for British houses all the refining of raws that offered has yet to be explained. Perhaps the refiners will ventilate their grievance in Parliament.

Fifty Years Ago.

From the "Sugar Cane," March, 1870.

In this issue a description was given for the first time of the process of purifying sugar juice and syrups invented by BOIVIN and LOISEAU,[1] which had a certain vogue in its day. It had been adopted by Sommier & Cie., of Villette, France, for use in their refinery, which turned out 100 tons of loaves per day. This process depended upon the formation of the complex compound known as "sucrate of hydrocarbonate of lime," produced by passing carbonic acid into a solution of calcium sucrate, so as to partly decompose it, an insoluble body containing sugar, lime, and carbonic acid in definite proportions being obtained. In the Sommier refinery its purifying effect was taken advantage of by adding it to the contents of the blow-up, in the place of blood or char dust, the syrup (at 30° Bé.) being then brought to boiling point. Alternatively, the sucro-carbonate might be added to juice or syrup, and carbonated, the calcium carbonate filtered off, and the liquor concentrated. It was claimed that this method of operating was capable of effecting a great saving of charcoal, while increasing the yield of sugar. It later became installed into a number of factories and refineries, particularly in France.

An article appeared in this number advocating the production of beet sugar in the United Kingdom. While giving some particulars of the industry as carried on in France, it was stated that the sucrose content of the roots cultivated at that time was about 10-11 per cent. Diffusion was not in operation for the extraction of the juice, and the method of pulping and pressing was still followed. Clarification was effected by the addition of a small quantity of lime only, not by carbonatation, and the syrup obtained on evaporation was passed through animal charcoal. After pointing out the advantages accruing from the beet industry on the Continent, the writer remarked that "as regard the United Kingdom, it cannot but cause some astonishment that a country ranking first in agriculture, and doubly so in everything relating to manufacturing, should hitherto have lagged behind in the successful carrying out of this industry, a fact the more to be wondered at since the cultivation of root crops is very extensively carried on . . . If the matter were to be properly taken up . . . there is no doubt that it might become a source of great improvement and well-being to the rural population of the country."

M. DUBRUNFAUT published a paper on the separation of levulose from invert sugar, describing a method in which 100 c.c. of a syrup containing 10 grms. of sucrose were inverted with hydrochloric acid, treated with 6 grms. of calcium oxide, and cooled in melting ice. The separation of levulosate in this way, it was considered, was so complete as to be "usefully applied to the analysis of fruit sugars and of all products which contain invert sugar, such as honey, cane molasses, etc."

A contribution by GASTON TISSANDIER gave a scheme for the analysis of animal charcoal. Carbon was found by subtracting the moisture from the loss on burning, and the phosphate of lime by adding ammonia to the solution obtained on treating the ignited char with hydrochloric acid. Iron, organic matter other than carbon, calcium sulphate, and calcium sulphite were not determined.

In a letter to the Editor a writer under the pseudonym of "Alerta" commented upon DR. ICERY'S monosulphite of lime process,[2] pointing out (what indeed one would expect) that the product obtained by the procedure described for its manufacture was a mixture of calcium bisulphite, normal calcium sulphite, and calcium sulphate. Its action was due to the evolution of sulphur dioxide by the acids of the cane juice, and by the subsequent heating of the juice; and the writer had found that a sample of the sugar made by ICERY's process contained a distinct trace of sulphite on being dissolved in water.

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[1] English Patents, 54 of 1867; and 3093 of 1883.

[2] *I.S.J.*, 1919, 428; 1920, 71.

Notes on the American Sugar Industry.

By our American Correspondent.

The sugar trade here is gradually working its way back towards normal conditions. Uncertainty as to whether governmental supervision of the industry was to extend during 1920 continued up to the very end of December. The bill authorizing the President, through such agency as he might designate, to purchase sugar during the present year, but limiting the application of licensing authority to July 30 so far as domestic is concerned, finally received the signature of President WILSON on the last day of the year. This had the effect of maintaining the existence of the United States Sugar Equalization Board which otherwise would have gone out of office with the expiration of 1919, and also preserved the authority of the Government to continue in operation the regulatory powers which it has exercised during the past two and a half years.

Announcement was immediately made, however, that the Sugar Equalization Board would not attempt to purchase Cuban sugar and would not interfere in the operations of the sugar trade except in case of some emergency requiring its action. It was generally understood that this decision was made on the recommendation of the Equalization Board itself, its members holding the opinion that under the conditions then existing it could not purchase Cuban sugars on any better terms than could individual buyers and that, if the Board kept out of the market, some recession in the high prices demanded for Cuban centrifugals at the commencement of the year would be likely to take place once the Cuban campaign was well under way.

By the second week in January, therefore, the sugar trade was officially assured that the ordinary machinery of commerce would be depended upon for the purchase and distribution of the country's sugar supply. Prior to that time many individual operators had bought Cuban centrifugals on contract and had made arrangements for the refining of this sugar on toll. The refiners themselves, however, had made very limited purchases in Cuba. Their policy in the main has been to buy only such supplies as were available for prompt shipment and to decline to enter into commitments for future positions at the prices which sellers have been asking.

For the past month, therefore, a trial of strength has been going on between the refining companies and the holders of Cuban sugars, the latter endeavouring to maintain prices at the level established at the beginning of the year and the former, by purchasing only for current requirements, attempting to force prices to lower levels.

Throughout January the advantage was with the Cuban producers. Quotations for 96° test Cuban centrifugals were maintained at 12 cents (6d.) a pound, c. & f., New York, equivalent to 13·04 cents, duty landed. The strikes of dock and railway workers in Cuba which tied up shipping at the port of Havana and interfered with the movement of sugar to this market made it easier to hold up the price. With the ending of the strike early this month, however, the tide has begun to turn and quotations for raws have receded a full cent during the past week, standing now at 11 cents (5½d.) c. & f. Refiners are still confining purchases to current needs, plainly in the belief that further recessions will follow. Of course nobody expects the price of sugar to be low, judged by the level of last year, but predictions are made by some refiners that a price of 8 cents (4d.) for centrifugals may be reached in March and April.

Shipments of Cuban sugar to the United States to the end of January amounted to 352,000 tons, which is nearly 150,000 tons more than the amount of shipments in the corresponding period of last year. Shipments from Hawaii and Porto Rico, however, have been less by about 40,000 tons. Until the present week refineries have been able to operate only at partial capacity and the shortage of sugar among consumers, particularly in the Central and Western States, is still serious. Refined sugar is selling wholesale at 15 to 16 cents a pound (7½d. to 8d.), subject to the customary cash discount of two per cent., and refiners generally are restricting deliveries to their regular trade. With sugar coming forward in greater volume from Cuba, however, it is expected that refined will be in better supply very shortly.

Statistics of sugar consumption in the United States during 1919 were made public recently. They show that the total amount used during the year was 4,108,000 long tons or 87·6 lbs. per capita, assuming the population of the country as 105,000,000. This is the largest amount ever consumed in any one year and represents an increase of about 14 lbs. per person over the previous year.

In comparing consumption during 1919 with that of the previous year, account must be taken of the fact that in 1918 the use of sugar was limited by a system of voluntary rationing. Removal of this restriction naturally would result in somewhat more liberal use but it would not account for a volume of consumption larger than ever before attained. This heavy consumption is ascribed by the trade to the general business activity that prevailed throughout the year and to the fact that labour was fully employed at the highest wages ever paid. Prohibition of of the sale of alcoholic liquors is regarded as another factor contributing to a freer use of sugar, but this is generally considered of minor importance in comparison with high wages and general prosperity.

An interesting question in this connection is whether a further growth in the use of sugar will be shown this year. Business activity shows no appreciable slackening and wages are higher than last year, so that it is logical to assume that the demand for sugar will continue to increase though perhaps not in the same proportion as during 1919.

In those lines of manufacture in which sugar is extensively used, such as the bottling of "soft" drinks, the manufacture of confectionery, ice cream, condensed milk, and tobacco products, domestic trade is on a scale of increasing activity though the exchange situation apparently will force some curtailment of export trade. *Facts About Sugar* has collected the opinions of leading manufacturing companies in these various trades. These opinions indicate a probable increase in the quantity of sugar used in manufactures amounting possibly to 250,000 tons for the year. It would not be surprising if the total consumption of the United States reached a figure of 4,500,000 tons in 1920, providing that amount of sugar is available.

One of the aims of the Department of Overseas Trade is to bring its Overseas Services into close personal touch with business men, and British firms when sending representatives abroad are recommended to instruct them to call on His Majesty's Consular Officers in the countries they visit, and on the Commercial Diplomatic Officer in the capital of each country, and in the case of the Dominions on His Majesty's Trade Commissioners.

A Tropical Agricultural College for the British West Indies.

Recommendations of a Government Committee.

A White Paper (Cmd. 562)[1] has just been published containing the Report of a Committee appointed by the Secretary for the Colonies last August to consider the desirability of establishing a Tropical Agricultural College in the British West Indies.

This Committee was under the chairmanship of Dr. A. E. SHIPLEY, LL.D., Sc.D., F.R.S., Master of Christ's College, Cambridge, and the members included Sir DAVID PRAIN, C.M.G., C.I.E., F.R.S., Director of the Royal Botanic Gardens, Kew; Sir NORMAN LAMONT, Bt.; Sir OWEN PHILIPPS, G.C.M.G., M.P.; Sir FRANCIS WATTS, K.C.M.G.; Sir EDWARD DAVSON; Dr. C. A. BARBER, C.I.E.; Mr. ROBERT RUTHERFORD, Chairman of the West India Committee; Mr. E. A. DE PASS; Mr. G. MOODY STUART; and Mr. A. E. ASPINALL, C.M.G., (Hon. Secretary).

The Committee were at the outset unanimously of the opinion that steps should be taken at an early date to found a Tropical Agricultural College in the British West Indies, in order that our colonies and possessions might be placed in a position to compete successfully with foreign countries in the production of the staples of the tropics; it was of paramount importance that their young men should be afforded opportunities for instruction in the principles of agriculture, and in the preparation for market of tropical produce including especially sugar and its by-products, rum and molasses. "Equally important is the need which exists of making full provision for the prosecution of research and for the training of scientific investigators in matters pertaining to tropical agriculture amid suitable surroundings, and for creating a body of British expert agriculturists well versed in the knowledge of the cultivation of land in the tropics, and of scientific advisers possessing an intimate knowledge of the means of combatting pests and diseases the control of which is fundamentally essential to the successful development of agriculture in the tropics." The Committee had their attention drawn to the successful tropical agricultural colleges in Porto Rico, Hawaii, and Louisiana, especially the "unrivalled sugar school" at Audubon Park, New Orleans, and they place on record their view that it would be a reproach if Great Britain were to remain behind the United States in this matter. They emphasize the fact that the establishment of a tropical agricultural college in the West Indies is a matter of Imperial concern. Such a college would be of no less importance to the mother country than to the colonies immediately concerned, having regard to the present necessity of developing production throughout the Empire to its utmost extent, and to the opportunities which it would afford students trained in agriculture in Universities in the United Kingdom to continue their training as post-graduates in the tropics.

As regards the situation of the college, the Committee after hearing evidence in support of the claims of the various colonies, decided to recommend Trinidad as the most suitable centre, providing that the Government there was prepared to afford the college adequate support and every reasonable facility. The general desire that the college should be closely associated with the Imperial Dept. of Agriculture and the fact that Trinidad possesses a wide variety of industries and is easy of access by steamer communication to residents in the neighbouring islands and British Guiana, evidently weighed with the Committee in arriving at that decision. The claims of Jamaica were strongly urged by Mr. E. A. DE PASS, but the Committee reluctantly felt that owing to its geographical position and the difficulties of intercolonial transit with the Lesser Antilles, Jamacia must to some extent be treated as a separate unit in the matter. In view however of the great importance of that island's agricultural interests there should be, in the Committee's opinion, intimate co-operation between the Jamacia Agricultural Department and the Imperial Department of Agriculture, and it would be an advantage to Jamaica to identify itself with the proposed college.

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[1] To be obtained of H.M. Stationery Office, London. Price: 3d. post free.

In order to establish the college as a legal entity, it is recommended that at the start it should be incorporated in the United Kingdom as a company limited by guarantee, and ultimately the King should be petitioned to grant a Royal Charter of Incorporation.

As regards the constitution of the college, the Committee regard it as highly desirable that an intimate relationship should exist between the Imperial Department of Agriculture and the college, so they recommend that in the first instance the Imperial Commissioner of Agriculture should be the Principal, and that thereafter the Trustees and Governors should nominate a principal who might also hold the position of Imperial Commissioner should the Colonial Secretary desire to appoint him to that office. The Trustees and Governors should be a body composed of (*a*) ex-officio, (*b*) nominated, and (*c*) co-opted members, and should constitute a Governing Body whose meetings should ordinarily be held in London. Of the nominated members, it is suggested that two should represent the Colonial Office, one the Academic Board of the college, six, say, represent the contributing colonies, five the contributing industries, and three the academic institutions in the United Kingdom. In all it is suggested that the Governing Body should consist of about 23 members.

It is recommended that the Staff should include teachers with the status of Professors in the followings subjects; General Agriculture; Mycology; Entomology; Agricultural Chemistry; Organic Chemistry; Agricultural Bacteriology; Agricultural and Physiological Botany; Genetics; Sugar Technology; and Agricultural Engineering and Physics. The curriculum should be based on some suggestions put forward by Sir FRANCIS WATTS, and might consist of (*a*) a junior course of instruction in tropical agriculture extending over two and possibly three years, and arranged to meet the requirements of youths leaving Secondary Schools. (*b*) A senior course of similar instruction extending over not less than four years. (*c*) A course of two years' instruction in more advanced tropical agriculture for students who have undergone a course of instruction in general agriculture in a recognised institution. (*d*) Post-graduate study of special agricultural subjects in their tropical application, as, for example, Entomology, Mycology, Chemistry, Plant Breeding.

In addition the Committee strongly recommend that a sugar school equipped with a complete plant on a small but working scale be established in connexion with the tropical college and so supply the urgent need which exists for the provision of scientific and technical training in sugar manufacture. They believe that the leading sugar machinery manufacturing firms would be willing to contribute different portions of that plant.

For the establishment of this college, a fund of £50,000 and upwards will need to be raised by private subscription. For its maintenance annual subscriptions should be invited from the various colonies on the basis, say, of a percentage of their annual revenue. Annual contributions should also be invited from the

Imperial Government as grants-in-aid. And, finally, voluntary contributions could be invited from industrial organizations and individuals interested in tropical industries.

The Committee conclude by expressing the hope that the Imperial Department of Agriculture may be established on a more permanent basis after the expiration of the present Imperial Grant, so that it may remain closely associated with the Tropical Agricultural College.

After the Report of the Committee was approved, a message was received by them from the Chairman of the Jamaica Imperial Association stating that his Association would support an initial grant of £50,000 and £5000 annually towards the College if Jamaica was made the headquarters of the college and the Imperial Department of Agriculture. The Committee, whilst adhering to the recommendations contained in their report, suggest that, in the event of Trinidad and the Windward and Leeward Islands not seeing their way to support adequately the proposed Tropical Agricultural College—a contingency which the Committtee hope may not arise— the possibility of establishing the College in Jamacia may again be considered.

Agricultural Notes.

The value of tree planting on sugar estates.—Much has been and will be written on the subject of tree planting in connexion with agriculture. We are familiar with the point of view of the pioneer planter who, on starting his new plantation, has as a first step to clear the jungle, and finds the larger trees and the stumps somewhat of a nuisance. Having served his purpose in providing the deep rich soil, the forest must be got rid of at the earliest possible moment and with the least expense. But he does not usually clear it all and each block is separated from the next by a wall of forest for protection against untoward weather. Wind breaks are of value in the plains as well, wherever there are occasional storms or recurring heavy winds, and the tall masses of sugar canes are specially liable to be laid by these; but one rarely meets with them. In forming the Experimental Sugar Station at Coimbatore in South India, the writer soon found the need of wind breaks, and their inauguration and arrangement was studied with the greatest care. Further, in issuing permits for the felling of forest for plantation purposes, Government has often a good deal to say as to the locality and the extent of clearing, for it is now recognized everywhere that the mountain forests are a valuable property in respect of the water requirements of the cultivators in the plains below. They accumulate the rainfall as in a sponge, and change the flow of the rivers from devastating torrents lasting a few hours to streams supplied with water for many months if not throughout the year. This is probably by far the most important function of trees in connexion with agriculture in the tropics.

The writer may illustrate this point by an experience in the island of St. Kitts some thirty years ago. This West Indian island may be roughly described as a gigantic mole-hill of rich, light, volcanic soil, some 4000 feet high, somewhat elongated in one direction. There is a cap of forest at the top, then comes a broad strip of grass land and, still quite high up, the sugar estates begin; and these, with a steep decline, spread down to the base of the mountain, with a strip of level coast land along the sea. On one occasion the effect was noted of a sudden heavy fall of rain. A trench was ploughed out from the upper estates to the sea, estimated at one mile long, twenty yards broad, and on the average three feet deep, right through the cane fields. The water had carried down masses of earth and cane plants and smothered the cane fields on the level, besides throwing masses into the sea. In this case the cap of forest was insufficiently broad for protection. If the grass land, of comparatively little value, had been planted up with trees, and belts of trees had been formed at various levels, the enormous damage done by such occasional rains would be avoided; the water would have been largely held up by the forest and let out gradually, while each belt of trees would have helped to retain the useful surface soil and prevented its loss and the destruction of the lower plantations. In the United States, it has been estimated that a billion tons of the best soil from the most fertile parts are lost annually by being carried into the ocean, because of the absence of such forest protection of the higher lands.[1]

These are perhaps the two main uses of trees in regard to sugar estates—windbreaks to shelter the canes from heavy winds and, in some places, drying winds and in others cold winds; and in higher altitudes the holding up of water, which if unchecked will rush down with uncontrollable force, whereas if checked will form perennial streams, whose slower flow will be beneficial instead of harmful. The effect of this change in places dependent on irrigation cannot be estimated too highly. It is not often that sugar estates in the plains can have much direct influence in the latter case, excepting by their support of Government in its forest policy. But we note with interest that in the Hawaiian group of islands, which are almost entirely dependent on the sugar plantations for their prosperity, tree planting has become an important branch of the Sugar Planters' Experimental Station. Not only are nurseries opened for the planting up of the spurs of the mountain ranges, but every waste piece of land on the estates is being vigorously planted up with trees. The number of trees put in exceeds one million annually, chiefly through the agency of private sugar companies.[2] The matter is, in Hawaii, obviously not merely of academic interest, especially when one considers the extremely business-like way in which the planters are bent on improving the outturn of sugar on their estates.

The matter of tree planting is, we think, worthy of consideration by all managers of sugar estates. The merits of each case will of course always have to be considered, for it is quite clear that the comparative usefulness of the practice will vary enormously under different conditions. It would be idle to plant trees where their roots could interfere with the proper growth of the canes, although the injurious effects of different species has been proved to differ very greatly. Bamboos, Java plums, and tamarinds may be given as specially injurious if planted near the canes, whereas many leguminous trees such as Albizzias and rain trees and various forms of Ficus are to all appearances less harmful. By digging trenches four feet deep and clearing these once a year it has been found possible to grow excellent cane crops right up to tamarind trees. Provided that there is plenty of overhead sunlight the sugar cane, in fact, appears to be very grateful for lateral shade and protection. Along the paths and roads, around the bungalows, and near the coolie line, in waste places and along the larger water channels, there is plenty of unoccupied land which can be planted up. Among the minor uses of such trees would be the production of leaf mould, pieces of timber for the smaller implements, firewood, etc. They would form resting places for the cattle and labourers during the heat of the day, would give cover to the insectivorous birds and would afford some protection against the extremes of climate, besides the purely aesthetic aspect, which has its value. All of these uses would vary according to the local conditions of the country. As to the kind of trees to be planted, this would of course be dependent on the purpose aimed at and the character of the local vegetation. As a general rule, introductions from other countries should not be attempted on a large scale without very careful consideration. It is a good principle, meantime, to select from among the trees growing around such as are seen to be thoroughly healthy, and multiply them as labour and time are available. The one thing to guard against is their injury in the younger stages by stock and goats. Bamboos are always useful, and there are many kinds suited to all climates. The work is cumulative in its effects and, with a little care, planting can usually be done at any time of the year, when other work is not pressing.

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[1] C. S. Judd, "Forestry as applied to Hawaii": The Hawaiian Forester and Agriculturist 1918, 119.

[2] Report of the Committee in charge of the Experimental Station, Hawaiian Sugar Planters Association, for the year ending September 30th, 1919.

On a danger in the use of nitrogenous manures in sugar cane cultivation.—When we take up the study of soils under cultivation in the tropics, it becomes difficult to lay hold of any general principles, because of the enormous variation in their character and behaviour in different regions. We may have clayey or sandy soils derived from various sources, basalts, lavas and other volcanic soils, the alluvia of great rivers, and a hundred variations in all of these. The cane likes a clayey loam, especially as it gives a good support in places where there are heavy winds at times, but excellent crops can be obtained from lighter soils, and especially such as have a volcanic origin. The chemical composition and physical character of the cane soils differ very much; they may be rich in plant food or on the borders of permanent sterility; they may be new soils reclaimed from grass land, savannah or forest, or they may have been cultivated for countless generations; there may be no rotation of crops, or cane may be alternated with various "dry" crops or "wet" paddy. It is obviously impossible, without some more or less accurate knowledge of local conditions, either to form an opinion as to the probable success of taking up new land or to lay down the correct form of manuring so as to increase the crops already being reaped.

But, taking a wide view of tropical agriculture generally and cane cultivation in particular, we may be justified in making some observations of general application. The first and most important requirement is that of water; this is a limiting factor in cane cultivation, for, without a well distributed and adequate rainfall or a suitable source of irrigation in its absence, it is useless to attempt it. Further, from a study of the many analyses of the soil made at different times and in different places, we find a generally marked deficiency in plant food; this is especially the case as regards nitrogen, but the quantity of available phosphorus and calcium is usually very small and this is also the case sometimes with potash. The first of these is easily the most important element for the sugar cane. It has been found as the result of experiment that the yield of sugar often varies directly with the amount of nitrogenous manure applied. Nitrogen in the soil may thus be also designated a limiting factor in successful sugar cane cultivation. But the form in which it should be applied appears to vary considerably in different places. There are two ways in which, in nature, nitrogen is constantly being added to cultivated soils. In temperate regions, if the land is allowed to lie fallow, the amount of nitrogen steadily increases, but it is doubtful if fallowing will be found as useful in the tropics. It is a case of bacterial action, and it is at least probable that the great heating of the surface layers by the sun will interfere with the multiplication of these bacteria. There is however a second set of bacteria whose action we know more about, and these require first and foremost a supply of humus for their action. Owing probably to the rapidity of chemical change in tropical soils, there is unfortunately a marked scarcity of this substance in them, and this is the apparent cause of the general poorness in nitrogen referred to above. There are many ways in which humus can be augmented in cane cultivation, and every good farmer has this matter constantly in mind. The addition of plenty of cattle manure is of course the easiest way where it is available, but there is hardly ever sufficient for the purpose, the return of cane trash to the soil or the introduction of a green manuring crop are both good, but we will not delay in discussing this matter here. In modern cane cultivation it is usual to add nitrogen in the form of some artificial manure, such as oil cake, guano, fish refuse, nitrolim, sodium nitrate or ammonium sulphate, and the particular form varies with the local conditions. Thus, in India, oil cake is almost universally regarded as the best form for the growth of the thick or tropical canes, while Java seems to prefer ammonium sulphate and Hawaii sodium nitrate; the relative claims of the two latter have been the subject of innumerable experiments for many years past. Exactly what form of application is preferred, whether bulky organic or concentrated artificial manure or the indirect effect of growing a green manure crop, must be decided on the merits of the individual case and with an eye to the general balance sheet. It should however be remembered that artificial manures are gradually becoming permanently dearer and that any methods of aiding the natural work of the bacteria often demand a great deal of labour.

All are agreed on the necessity for this increase in the nitrogen of the soil, but there is a danger to be guarded against in the use of nitrogenous manures, especially concentrated artificials, when little account is taken of the general improvement of the physical condition of the soil. And this danger is especially obvious in those lands which respond most readily to such treatment, namely those long under cultivation and approaching the lower limit of fertility. We have noted that tropical soils are markedly deficient as a rule in phosphorus and lime and sometimes in potash as well. Now all of these are required for the healthy growth of crops, and it is not impossible for a great growth of canes to use up all the available supplies of these and thus lead to a temporary or permanent impoverishment of the land. This danger can be guarded against by a rather full series of chemical analyses of the soil at regular intervals and the addition of waning elements, but the result of such analyses is not always satisfactory because of the important bearing of the physical texture of the soil. Better cultivation is a surer method, as well as the routine addition of vegetable matter such as cane trash, waste molasses, filter press cake, or crops purposely grown for digging in, for in all these cases salts are returned to the soil. Lastly, the application of a "complete" manure would be effective, especially where expert chemical advice is not readily obtainable; the risk would be run of a wasteful addition of some element which is not needed, but this is better than the loss incurred in a diminished yield of the much more valuable sugar in the crop.

C. A. B.

The Report of the Patents Laws Committee of the Conjoint Board of Scientific Societies advocates the following improvements in British Patent Law: (1) Extension of the present period of provisional protection; (2) extension of the period of protection from 14 to 17 years (as in the U.S.); (3) reduction in the scale of fees, the present charge for the first four years to remain, but all renewal fees to be substantially reduced; and (4) adoption of the "file wrapper" system (as employed in the U.S.)

The Identity of Canes grown in Argentina.

By G. L. FAWCETT.

Botanist and Plant Pathologist, Agricultural Experiment Station. Tucumán, Argentina.

In a recent bulletin issued by the Insular Experiment Station of Porto Rico,[1] it is stated that the variety of cane known in the Argentine as Java 36 is not the true J. 36 (P.O.J. 36) of Java. This statement is erroneous. Our Java 36 is the true P.O.J. 36 as it is grown to-day in Java.

The idea that the P.O.J. 36 of this country is not correctly designated probably owes its origin to the description of this cane in NOEL DEERR's "Cane Sugar," in which, in a description too brief to be of any real value, it is given as a green cane with cordate buds. As a matter of fact, it is a rather purple or purplish cane with round projecting buds. Sometimes slender, green stalks are produced in the centre of the stools which are really green. Typically, the internodes are green, with fine purple stripes, these being often so numerous as to completely obscure the green colour. In no event, however, is it to be described as a green cane.

In 1917, the Director of this Station sent a description of this cane to the Java Station at Pasoeroean, asking whether it agreed with their P.O.J. 36. The reply was to the effect that the description fitted very well with their variety of this number, it being added that the description in "Cane Sugar" was wrong. Later we received the very accurate descriptions made by DR. JESWIET,[2] the cane identification specialist of the Java Station, which descriptions, translated into Spanish, appeared in the *Revista* of this Station for February 1918. These descriptions settled definitively any questions as to the identity of our Java canes, inclusive of the P.O.J. 36, with the varieties bearing similar designations in Java. If further proof is necessary it is to be found in the fact that labelled canes of each variety sent from Argentina to Java have been pronounced by DR. JESWIET to be the same as the Java grown canes to which they correspond in number.

The J. 36 of Porto Rico, known in that island as J. 56, is the same as our P.O.J. 36, the cuttings for the first planting there of this variety having been selected by me from our original lot of this variety. It is therefore the same as the P.O.J. 36 of Java.

Formerly a doubt as to the identity of our varieties of Javanese origin existed here. In one of the earlier *Revistas*[3] it is stated that the J. 36 of this place is incorrectly classified. MR. A. H. ROSENFELD, in *Sugar* for December 1917, says that the names J. 36 (P.O.J. 36) and J. 234 (P.O.J. 234) as applied in Argentina have become interchanged, the J. 36 being the real J. 234 and *vice versa*, he apparently basing his descriptions on the inaccurate descriptions ascribed to Kobus in "Cane Sugar." We now know, with more accurate knowledge of the subject, that it was a mistake to regard these varieties as incorrectly labelled.

Another more serious inaccuracy, that of calling the variety J. 228 (P.O.J. 228) by two names, its own and J. 139, in other words of considering this variety as two distinct varieties, to which the names J. 228 and J. 139 are applied respectively, still persists here. In some instances, it is recognised that it is a question of one variety, but the wrong name J. 139 is made use of instead of the correct form.

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[1] Bulletin 19. The Resistance of Cane Varieties to the Yellow Stripe or Mosaic Disease, by F. S. EARLE.

[2] Mededeelingen van het Proefstation voor de Java-suikerindustrie. Landbouwkundige Serie 1917. No. 12.

[3] R. E BLOUIN. Una Comparación de los Resultados de los Ensayos con las canas de Java con los de las canas Kavangire, Zwinga, y del país. Revista Industrial y Agrícola de Tucumán. Vol. 4. No. 4. P. 141 (1913).

Although the name J. 139 still appears in articles on Argentine cane in this and other journals, it must be recognized that P.O.J. 228 is really meant, as the J. 139 does not exist here, except for a few plants in botanical gardens. I am informed that the incorrect designation—J. 139—is made use of in these articles in order to avoid the confusion which might result now if the correct form were employed after having made use of the wrong name in so many earlier papers, an explanation which seems sufficiently plausible.

In brief, our canes of Javanese origin are identical with the varieties of corresponding names as grown in Java. In no country, with the exception of Java, have the commonly grown varieties been more completely studied or more accurately determined.

The Sugar Industry in Hawaii.

There have been frequent notices of late in this Journal of papers describing the work on the sugar plantations of Hawaii, and the Report of the Experimental Stations there for the year ending 30th September, 1919, is, as usual, full of interest. As however many of the new lines of work started after the war have been somewhat fully referred to in last year's review,[1] these will receive less attention in the present notice, unless important progress has been recorded. It may not be out of place, on the other hand, to preface a consideration of the Report before us by a short discussion of the special conditions of the Hawaiian group of islands, by means of which such outstanding results have been obtained in the sugar industry. Much of the following description is based on the excellent account given by PRINSEN GEERLIGS in "The World's Cane Sugar Industry" in 1912.

Sugar cane is by far the most important crop in the Hawaiian Islands, the production from the four chief islands, Hawaii, Maui, Oahu and Kauai, where alone it is cultivated, having reached a total production in 1917 of 650,000 tons of sugar. The group is completely isolated and lies within a short distance of the northern limit of the tropics, rather over 2000 miles from the nearest American port, San Francisco. The climate is comparatively cool for the tropics and, there being a decided check in growth during the winter months, the crop is usually in the ground for the greater part of two years, with consequently heavy yields of cane. The cultivable area of the four islands mentioned is not large, the total extent being about 6000 square miles (a little smaller than Wales), with a great deal of useless mountain and rock. The islands are of volcanic orgin, masses of lava ejected by great volcanoes, and vary a good deal in age; Kauai in the north west is apparently of Eocene origin, Oahu and Maui having been successively formed at subsequent periods, while the largest, Hawaii, is of quiet recent formation. The amount of disintegration of the laval rocks varies accordingly a good deal in the different islands. Most of the volcanoes, by whose activity the islands have been built up out of the depths of the ocean, still exist as enormous masses of mountain, sending radiating spurs into the sea, and some of them reaching nearly 14,000 feet in height, with their summits clothed in perpetual snow. There is thus an absence of large level areas, the fertile soil being found of variable thickness in valleys or depressions between rocky masses of barren land. The soil is very rich in these depressions and also very porous, so that much of the rain that falls does not flow over the surface but sinks into the soil, and forms underground rivers towards the coast. The north-east trade wind blows for the greater part of the year, and, because of the mountain masses, the rainfall differs very considerably on the two sides of the islands, from very heavy annual falls on the east to little or none on the west. Because of this distribution of the rainfall, sugar cane cultivation was, in former times, largely concentrated in strips on the eastern coast, while nothing was grown on the barren western sides. These peculiar physical features are not met with in any other sugar cane growing country and it is not surprising that the industry has been developed on very special lines.

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[1] *I.S.J.*, 1919, 171.

The later history of the sugar industry in the islands serves as a remarkable testimony to the care of the United States in the development of its newly acquired Colonial possessions. The first recorded shipment of sugar is given as two tons in 1837: by 1876, when a reciprocity treaty was entered into with the United States, it had reached 13,000 short tons. With the aid of American capital, it rose to 229,000 tons in 1898, when the United States assumed sovereignty, and thereafter rapidly increased, in 1902 to 360,000 tons, in 1910 to 506,000 and in 1917 to 650,000. This later development, since 1898, may be said, in the first place, to be entirely due to the free entry of the sugar into the American market, and the prosperity of the islands is wholly dependent on the fiscal policy of the parent country. Anything in the nature of a world-free sugar policy would, according to Prinsen Geerligs, in all probability result in widespread disaster to Hawaii. Coupled with the duty-free entry of sugar into the United States, was the encouragement afforded by a settled form of Government to spend large capital in the development of the industry. This took the form of greatly improved machinery and intensive cultivation, but especially of enormous pumping plants and irrigation schemes, by which the underground water was tapped, brought to the surface and spread over the fields, the sugar cane area thus extending to many parts where the rainfall was entirely insufficient to grow agricultural crops. This part of the development has proceeded with startling rapidity, for, while before 1898 there were practically no large schemes of irrigation, the year 1904 is given by Prinsen Geerligs as that in which the irrigated area overtook that of unirrigated or rainfed, and this lead has been gradually increased ever since. This great expenditure of capital has carried with it others of almost equal magnitude. The laying down of light railways and water flumes of many miles in length for the carriage of the canes to the factory, the installation of up-to-date machinery and a great increase in the size of the factories, as well as extremely costly and heavy manuring, all have been justified by the richness of the cane juice and the immense yields of canes obtained. Irrigation has not been confined to the dry land area, but has been applied to that formerly growing cane under rainfall, as it was found that the land artificially watered gave much greater tonnage and consequent yields of sugar than that purely dependent on rainfall. While, in some respects, the work in Hawaii may serve as a model for cane-growing countries, it must be recognized that few have conditions favourable enough to justify such vast expenditure in growing the cane crop. And with regard to the enormous yields of sugar per acre reported from time to time, we must exercise a little caution when comparing them with those of other sugar growing countries. The bulk of the crop is in the ground for the best part of two years and, as a return on capital per cent. per annum, it should therefore be halved. The eight tons of sugar per acre in Hawaii would thus be comparable with the four tons of Java and the West Indies where the crop is an annual one. This point of view has been recognised in Hawaii, and a new standard of production has accordingly been introduced. In place of tons-of-sugar-per-acre we have tons-of-sugar-per-acre-per-month,[1] and by this means we can compare the yields of plant cane, first and subsequent ratoons, both short and long. It is interesting to note that by using this method a very similar return per month has been obtained in the Experiment Station for short or long periods in the ground.

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[1] *I.S.J.*, 1919, 173.

The development of the sugar industry in Hawaii has, from the first, been carefully fostered by the local Sugar Planters' Association, the members of which have shown a fine spirit of co-operation and have spared neither time nor money in conducting experiments on a most extensive scale. In considering the scope of their enquiries, it is indeed difficult to find a point where effective work has not been done in the past, and the present Report clearly shows the wideness of their outlook and the generous nature of their expenditure in all directions. Perhaps one of the most unusual fields of activity for a sugar experimental station is that of forestry, which is fast becoming an important section of its work. Much of the land on the estates is rocky and uncultivable through the protrusion of coral and volcanic masses not yet disintegrated, and these barren parts, together with the slopes and spurs of the mountains, are being steadily planted up in collaboration with the newly formed State Forestry Department, for the purpose of maintaining, if not increasing, the water supply of the irrigated lands. The rate of tree-planting in the island now reaches over one millon trees a year, and the sugar estates are bearing their share of this important work, and have opened special nurseries and gardens for the study of the relative value of introductions from other countries. The effect of this work cannot but be beneficial to the soil in the near future. After many years of reckless squandering of the magnificent resources of these fine islands, every effort is now being made to conserve and improve them, a matter of elementary economics if one considers the increasingly heavy drafts made upon the soil every year. The fact that the new systems of irrigation have been proved to wash out the potash and calcium salts in alarming quantities is receiving very careful consideration, and, where necessary, this loss is being countered by increasing doses of artificial manures. Another line of activity is the study of the labour question, for here, as in the majority of tropical countries, this issue is becoming a dominating factor. The population of the islands in 1917 was estimated at 250,000 and the labour employed on the sugar estates at 46,000, in both cases (but especially the latter) largely consisting of Japanese immigrants. The natives are comparatively few in number, and are more or less useless for work on the plantations, and the laws of the United States are inimical to the usual labour replenishment of the tropics. Labour-saving appliances are therefore everywhere to the fore, sometimes it is to be feared to the detriment of the best interests of cultivation. For instance, it is said to be the practice now to burn the fields before cutting, which appears to involve a regrettable loss in humus-making material. With such a loose soil, it will naturally occur to the observer that humus is just what is wanted to make it more retentive and thus counter the washing out effect of irrigation, besides greatly increasing the food for nitrogen-fixing bacteria. Rigid economy is now being practised in the factory as regards the employment of labour, and the same is being extended to the fields, but it is an open question how far this can be economically applied, in the long run, to the cultivation.

All branches of study appear to be well represented in the Report. Soil surveying has been commenced in Kauai; chemical and physical analyses of the soil, bacteriological studies, manuring and soil treatment in the widest sense, factory inspection, the maintenance of the quality of commercial sugars for refining purposes, uses of by-products such as filter-press cake, the constitution of final molasses, plant-breeding and selection, fungus diseases and insect pests, a thorough study of the economics of the industry in factory and field with the object of lowering the cost of production, and a consideration of new standards for estimating the quantity of cane and sugar produced under different conditions—all of these are receiving attention.

The serious Lahaina disease, so called presumably because of the susceptibility of that cane to it, continues to be carefully studied, and there is at length some promise that its immediate cause has been ascertained. This root rot, it is claimed, is identical with similar rots in the pineapple, taro, banana and rice, and is caused by a definite fungus parasite. LYON asserts that this is a form without hyphae, presumably belonging to the Chytridiaceae, while CARPENTER,[1] who is joining the Department, writes that it is a distinct fungus with hyphae which disappear when the oospores are formed, and which is related to *Pythium de Baryanum*. This, if true, is a great step in advance, but of course does not necessarily mean that the asserted degeneracy of that fine cane, the Lahaina, will be more readily checked.

The Leaf-hoppers continue to decrease in numbers with the multiplication of the introduced egg-parasites. But a number of insects have been noted as feeding on the eggs of the parasite itself, and these are being carefully watched. A further attempt at introducing enemies of the leaf-hopper has resulted in bringing, among others, a number of Dryptus and Dryptus-like beetles from Queensland, and a nursery is being formed in that country for the collection of further supplies of these and other beneficial insects.

The Anomala attack on the cane roots appears to be definitely checked and the Scolia wasp from the Philippines, which has eaten out the Anomala grubs, is apparently hard put to it to find food. At present it is clearing out the similar root borer, Adoretus, but is already decreasing in numbers.

The eye-spot disease is causing some misgiving, because of the marked susceptibility of H 109 to its attacks. Instances are given where, in the wet seasons of 1917 and 1918, certain plots of this cane were so badly attacked that the resulting crop was considered a total failure. Where the disease is prevalent the planting of other varieties is recommended, which makes it important that this fungus disease should be fought with some energy.

A new Sereh-like disease is described which has much the form of that mentioned in the December number of this Journal.[2] It apparently differs from the true *sereh* in that, when diseased stools or parts are grown in the Honolulu Experimental ground, they develop into normal healthy plants. Such occasional stunted forms with small leaves and no flowers (in the sugar cane no flower-forming canes) have been noted by the writer in many wild and cultivated plants in the tropics, and their cause is not usually known ; it does not appear that the disease in Hawaii, as described, differs from the rest or is a matter for great concern.

The new leaf disease mentioned, in which the leafy tuft fails to expand and the upper end of the shoot ultimately breaks off, presents a very peculiar and characteristic appearance. It is supposed to be the work of a fungus, which, only able to attack young tissues, enters the young shoot at that point where it is no longer protected on the outside by older leaves, that is half-way up. It then eats its way right across, killing the upper part of each leaf. It might be suggested that, if the fungus attacks only young parts, it is not easy to understand why it does not eat its way downwards into the ever younger tissues until it reaches the heart. But this mode of progress is not mentioned in the Report. In some respects it reminds the writer of a disease noted on sorghum in India, where the tuft of leaves remained folded in spite of obvious pressure from below, and when ultimately burst open showed a curiously ragged and often cohering set of leaf ends. This disease was attributed at the time to excessive growth during an early period of wet weather followed by the drying up of the ground, which checked the expansion of the forced and overgrown shoot. No details are given of the weather conditions under which the disease appears in Hawaii.

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[1] C. W. CARPENTER, Preliminary Report on Root Rot in Hawaii, Press Bulletin, No. 54, Hawaii Agricultural Experiment Station, Honolulu.

[2] C. A. BARBER, The Growth of the Sugar Cane, III, *I.S.J.*, 1919, 601. An example of sereh like disease is shown in fig. 1, opposite to page 602.

The work of the Chemical section was referred to in some detail in the review of last year's Report [1] and needs little additional here. The plantation soils of four estates in Kauai are being studied in the following respects, as a commencement of a detailed soil survey:— moisture coefficient, plant food, ammonification, nitrification, nitrogen fixation. The most significant result at present obtained is the general poorness of the soils in phosphorus. In experiments at Waipio substation in Oahu, this poorness was much more pronounced in the higher soils, which we think was the case with the phosphorus experiments in Porto Rico. A marked correlation was found between the laboratory estimates of phosphoric acid, by the 1 per cent. citric acid method, in the soil and the relative value in the field of the addition of phosphatic manures.

Of the varieties largely grown, H. 109 is steadily increasing in area and there appears to be as steady a decrease in the area under Lahaina. D 1135 is also said to be increasing in favour. A table is given of the selection work on the seedlings produced from 1911 to 1918, which shows that some of the seedlings of each year, including the earliest, are still being retained as of promise. A large number of seedlings have been obtained in the year under report, but apparently no crossing is being attempted; the parentage, presumably only female, was, in order of importance:—H. 109, Lahaina, H. 458 and H. 146, these four parents producing the great bulk of the seedlings obtain. Two new seedlings are now being brought to notice which, after three years' growth, appear to be of great promise, namely H. 5001 and H. 5802. A commencement has been made in the study of correlations between morphological characters and richness of juice in seedlings. Thickness of stem and area of leaf surface have thus far given negative results. It would be worth while to consider whether such a study of correlations might not with advantage be confined in the first instance to seedlings of the same parentage, in which both mother and father are known. The results obtained by the writer and published in 1916 would appear to suggest that the correlations referred to may differ with the parentage.[2]

Lastly, some work has been done on the losses incurred by delay in milling. The comparatively dry air and coolness of the climate in Hawaii permits the canes to stand in the field without deterioration for a longer time than in the moist heat of the West Indies and Java, but, when cut for the mill, the losses both in weight and quality of juice are considerable. It is interesting to note that this is less so in H. 109 than in the others experimented with. The canes were tested in bundles of 50 and weighed every two days; the losses were in eight days, for Lahaina, 0 to 12·4 per cent.; for H. 109, 0 to 13·0 per cent. and for D. 1135, 0 to 12·0 per cent. The losses in quality during the same period were greatest in Lahaina, next in D. 1135 and least in H. 109. By combining the two, the loss in available sugar was determined as 47·4 per cent. for Lahaina, 42·0 per cent. D. 1135 and only 34·9 per cent. for H. 109, giving one more point in favour of the latter fine cane.

C.A.B.

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[1] *I.S.J.*, 1919, 172 *et seq.*

[2] C. A. BARBER, Studies in Indian Sugar Canes, No. 2. Sugar Cane Seedlings, including some Correlations between Morphological Characters and Sucrose in the Juice. Memoirs of the Department of Agriculture in India, Botanical Series, vol. VIII, No. 3, July, 1916.

Australian Affairs.

(From our Special Correspondent).

The 1919 sugar season, which is now to all intents and purposes a thing of the past, proved a source of much anxiety to all concerned. The first setback occurred owing to the effects of the terrific cyclones in the early part of 1918, which caused much more damage to the canefields than was supposed at the time and left them, after the crushing of that year, in a bad state, particularly in the Mackay and Babinda districts. Then the plantings of that year had a particularly bad season owing to the dry weather which supervened. However, fair rains fell in December and January; but these were followed, unfortunately, by a dry period. Then late frosts caused much havoc, and the dry spell continued until the crushing season came with the country still in the throes of one of the severest droughts known in this country. As a matter of fact, there has only been one drier 10-month period for 60 years, and it was recognized that several of the mills would not turn a roller. Six or seven did not do so, but the high price of fodder enabled many of the planters in the districts so affected to find a fairly remunerative market for their cane as food for cattle, and in some districts also the unfortunate farmers turned their attention to trapping marsupials for their skins, which were bringing in lucrative prices. Many of the planters, giving up all hope of a decent return from 1919, devoted their energies to the cane for 1920, but so severe was the drought that grave fears were entertained—particularly in the Bundaberg and Childers districts—as to the safety of even that crop. The State General Superintendent of Sugar Experiment Stations, writing in November last, said: "This year's crushing at Bundaberg may be said to have been a very disappointing one. Qunaba and Gin Gin do not crush at all, and Fairymead, Bingera, and Millaquin had only small crops to deal with. . . Given a good season it is expected there will be a fair crushing next year, but, owing to drought and scarcity of plants, the area planted is not so large as usual, and what planting will be carried out now that rain has fallen will probably not produce enough cane to be cut till 1921." It is only fair to state, however, that the Bundaberg and Childers districts were particularly hard hit, and suffered more than any other part of the sugar-growing districts of Queensland and New South Wales, so much so that large patches of cane died outright and many farmers were doubtful if they would have a crop at all this (1920) season. The crushing in the Childers district was absolutely the worst on record, being even smaller than that of the big drought of 1902. Of course in a huge coast-line like that covered by the sugar-growing country of Australia there was much diversity in the rainfall, and the Mourilyan sugar mill had a record crushing. The Northern Rivers districts of New South Wales had a fair crushing season, and few labour troubles. The Mackay harvest was a light one, but the "*c.c.s.*" was higher than was expected, and the crushing proceeded with only slight interruption from labour troubles. The "strike" of young cane was good, and gave promise of a good yield this year. In the Innisfail district, where the staple variety is Badila, better returns were obtained, mainly owing to good cultivation, more rainfall (although light), and a comparative freedom from cane pests. A large number of the farmers there are liming their fields with from 15 cwt. to 35 cwt. of pulverized limestone to the acre. The Badila variety also did well in the Cairns district, and the crops on the whole were good, whilst the same may be said of Babinda and the fields further north. Unfortunately, a shipping strike interfered to some extent with the coal supplies for the mills and also the shipping of raw sugar to the refineries. One redeeming feature of the dry weather was the keeping in check of the cane beetle, whose operations were on a very small scale during the year. It's an ill wind that blows no good.

Various estimates were made of the aggregate yield, some of which were wide of the actual mark, but the following, issued after most of the mills had finished crushing, will be found to be not far from the actual returns, and for the purpose of comparison I am also giving in parentheses the actual figures for 1918:—

Division.	Area Crushed. Acres.		Cane Crushed. Tons.		Sugar Obtained. at 94 N.T.	
1	41,866	(39,015)	734,000	(537,870)	96,435	(62,173)
2	33,173	(43,364)	396,657	(602,147)	49,909	(69,232)
3	8,232	(27,495)	61,774	(506,928)	5,693	(55,762)
4	1,721	(1,698)	30,670	(27,884)	3,358	(2,811)
Totals	84,992	(111,572)	1,223,101	(1,674,829)	155,395	(189,978)

It will thus be seen that, taking the estimated consumption of Australia for this year to be 280,000 tons, there remains somewhere in the vicinity of 125,000 tons to be imported to meet local requirements. In this connexion it may be mentioned that Mr. Massy Greene (Federal Minister for Trade and Customs), speaking with reference to the persistent rumours current regarding an increase in the retail price—which rumours have been rife throughout Australia for the past four months—stated that the Commonwealth Government had purchased foreign sugar to meet the shortage in supplies up to June 30th, 1920. "The price," he said, "need not therefore be increased, at all events, for some time to come, if at all." And it has not up to date. What action the Nationalist Government, which has just been returned to power, will take now that the elections are over is awaited with considerable interest by producer and consumer alike.

Had this letter been written a month ago only the direst forebodings could have been sent to your readers regarding the 1920 crop, but with the passing of 1919 came the break up of the driest period bar one (in 1902) in the sugar-growing parts of Australia for over 60 years. Generous rains commenced with the end of the year, and a week of glorious soaking rains has been experienced, which bespeaks an optimistic outlook for the sugar growers and the State generally. The Bundaberg and Childers districts have been well favoured and the plant cane saved, and should our usual wet season supervene in February and March the industry may well look forward to a return of aggregate figures akin to years gone by, for the response of these rich lands after a period of drought-rest is phenomenal.

The questions of the duty on sugar and the control of the Australian product (*i.e.*, Federal or State) are burning ones at the present time, and have been for some years past. The brewers and jam and confectionery manufacturers—particularly in Sydney, Melbourne and Tasmania—are clamouring for "free" sugar, whereas the producers of cane would welcome even a higher duty than the present one. Briefly the position may be put thus: For years, in order to ensure that the industry in a comparatively small part of Australia should be conducted by white labour, the whole of Australia, through the Federal Government, paid a protective duty of £6 per ton on any cheap grown sugars imported. In later years, however,—that is, since the war—the price of sugars has been higher outside than inside Australia. So how the manufacturers would benefit just now it is hard to conceive, seeing that sugar was selling recently in Java at £45 per ton f.o.b. Dealing with this matter, the last Budget speech in the Federal House stated:—"Prior to 1915, raw sugar was worth less than £14 per ton. When the Government fixed the price at £18 increases were granted in wages to the field workers. The increase in 1917 to £21 was followed by further increases in wages. Owing to Government control, sugar has been retailed, since January, 1916, at 3½d. per lb. for *1A* white granulated" (the present price). "In addition to the low price, Australia has enjoyed abundance of this commodity." So the general public have little to growl about. "Liberal concessions have been made to manufacturers of jams and other goods for export, sugar having been supplied to them at £24, and recently at £26, per ton. The Commonwealth Government secured contracts for supplying the British and United States Governments with jam at from 5½d. to 6d. per lb.—an unprecedented price for Australia—with the result that 72 million lbs., valued at £1,631,250, were supplied, the exports of that commodity jumping from less than 2 million lbs. in 1913 to 79 million lbs. in 1918-19. Special arrangements for freight were also arranged during that period. Of £268,230,000 worth of primary products handled by the Federal Government, sugar stands fourth on the list—amounting to 17 millions sterling,—and the sugar industry should also be credited with a large proportion of the amount represented by jam." So what have the manufacturers to complain of?

Now we come to the producers' side of the question, but before dealing with them let me add that the confectioners have no reason to cavil at the conditions obtaining, since, as stated by one of the largest manufacturers in Melbourne, "the increased cost of sugar did not affect them to any extent because, owing to the embargo placed upon the importation of confectionery, they were unable to supply local demands at a greatly increased price." The producer, on the contrary, has been forced all this while to take £21 per ton, a deputation's request for £24 being turned down by the Federal authorities. The cost of production, both in the fields and in the mills, has been steadily mounting; whilst the cost of living, which in the North has never been too cheap, has become almost prohibitive. Add to this that freights on raw sugar have gone up lately, a few instances being: From Bundaberg to Melbourne, from 26/6 to 42/- per ton; Bundaberg to Sydney, 21/6 to 37/-; from Bundaberg to Gulf of Carpentaria Ports, up to £4. By way of comparison, it may be mentioned that raw sugar was recently conveyed from Java to Melbourne at 30/- per ton. Is it any wonder, then, that at a large meeting in Mackay the other day the following resolution was unanimously carried? "That the importation into Australia duty free of foreign cheap-grown sugar threatens the complete annihilation of Queensland's principal agricultural industry, and also that of many important towns and cities which the sugar industry has called into existence along the coast from Bundaberg to Cairns, and further north; and that it aims at undoing the great national service which the Queensland sugar industry has accomplished, in spite of many difficulties, in establishing close settlement conditions along the most vulnerable portion of Australia's coast line." It was decided at this meeting to initiate a fund for the purpose of carrying on a vigorous publicity campaign in the Southern States in the interests of the sugar industry; also to ask the State Government to convene a conference in Brisbane of representatives of the industry with the view of deciding on a common policy in regard to the internal economic needs of the industry and to consider a plan of campaign to combat that of the Southern manufacturers. The question of Federal *v.* State control I hope to deal with later.

The Real Situation in the Continental Beet Sugar Industry.

(From a Special Correspondent).

An important factor in the European sugar production besides the question of labour and the land is the lack of the necessary coal, which is a source of great trouble in every commercial state. The scarcity of coal not only affects directly the production of sugar from the beets in the sugar factories, but it also influences indirectly the supply of beets and their quality.

We glean from German papers the following particulars: "The General-Director KÖNGETER, chief of the Imperial Council, states that the coal production in the Ruhr district amounted in the last few months to 68 per cent. of the average output of the year 1913 and to 75 per cent. of that in the final months of 1918. In the Upper Silesian collieries the production was 70 per cent. of that of 1913 and 68 per cent. of that of the concluding months of 1918, so that in this case peace has proved still more detrimental to the coal production than war time. The production of brown coal, on the other hand, amounted in the concluding months of 1918 to 94 per cent. of that of the same period of 1918 and to 116 per cent. of the 1913 figures. The authorities have greatly stimulated the brown coal production, because of the utilization of that material for the manufacture of nitrogenous bodies, as well as of aluminium and the like."

In considering these figures it is not clear how so tremendous a coal scarcity can reign in Germany as appears to be the case; but we must not forget that the quality of the coal is much worse than before, because the product is not washed, but is shipped along with the slate mixed in the real coal. Further, the mines themselves consume much more coal for the working of the shafts, and the largely increased number of workmen, necessitated by the shorter hours, on their part consume much more coal than was allotted to their predecessors, who were less numerous. This makes the net output of real fuel much less than the gross figures might suggest. In the second place, large quantities of the best coal have to be handed over to the Allies in virtue of the peace treaty, and finally a heavy tonnage has to be sent to neutral countries in barter for foodstuffs, which cannot be paid for in money owing to the low exchange value of the mark.

The result is that very little coal can be at the disposal of railways, gasworks, domestic consumers, industry and agriculture. The stocks of coal for the railways have dropped to such a low level that in the winter months, in which usually the reserves are used, new supplies have had to be carried to the railway centres in order to keep the traffic going as far as this was possible. In order to be able to run the railways the supply for industry and agriculture has had to suffer. The blast furnaces could not continue their work, and many of them had to be extinguished, thus greatly decreasing the output of pig iron. The huge German works for the fixation of nitrogen from the atmosphere have not been able to carry on since the conclusion of peace and so have failed to supply agriculture with the urgently needed nitrogenous fertilizers. Agriculture can not obtain the necessary coal or electric current for steam or motor ploughs, for thrashing machines, or for drying apparatus for potatoes and other perishable agricultural products. It is said that in the vicinity of Magdeburg large tracts of land, which in ordinary days were ploughed with steam ploughs, cannot be worked properly this year, so this will have a notable influence on the results of the 1920-21 beet crop.

The indirect consequences to Germany of the lack of coal for the sugar industry are, therefore, defective tilling of the land owing to the deficiency of mechanical ploughing, and a lack of nitrogenous fertilizers which might have been made in the country as substitutes for the Chile saltpetre which is much too remote and too expensive to be used now. Further, new sugar machinery is lacking, as a consequence of the shortage of metals, chiefly iron; there is a shortage too of locomotives and railway rolling stock, and the conditions on the railways in general, together with the lack of fuel to drive the engines, handicap the transportation of the beets at the proper time; while, finally, the scarcity of fuel allotted to the sugar factories is a great hindrance to the regular working up of those beets which have actually arrived in the yards. These circumstances appear to be felt not only in Germany, but also in the whole of Central and Eastern Europe.

In some correspondence from Poland we learnt lately that even in 1918-19 only part of the beets could be worked up, while a great quantity of roots rotted away. The sugar industry of that country, which before the war produced 350,000 tons of sugar is in fact threatened with extinction if the lack of coal is not remedied. The sugar manufacturers in Western Poland are urgently calling for the speedy regularization of the coal supply by the sending of that material from Upper Silesia, and by improvements in the transport facilities. Several Polish factories are busy changing their furnaces to fit them for the use of liquid fuel which can be obtained in fairly sufficient quantities. It is chiefly for lack of coal and of transport that several large Polish factories have only been able to start work in January, or at a time when in ordinary years the whole crop would have already passed through the slicing machine and have been worked up into dry and well-manufactured sugar beyond reach of deterioration. The Polish government had reckoned to be able to export a not inconsiderable quantity of sugar, but, owing to the very bad results achieved, it has found itself obliged instead to try and obtain at least 25,000 tons from abroad. With the depreciation of the Polish mark, which is sometimes yet lower in value than its German namesake, it is evident that enormous sums are required to finance this transaction, which could have been spared the country if the beets actually grown and present had not been allowed to decay in the field or during transport.

Almost similar reports are heard from Czecho-Slovakia. During last summer the reports were very optimistic; we heard of estimates going up to 800,000 tons, while one report stated that there were beets enough in the field to produce 1,100,000 tons of sugar. This was much too sanguine at any rate, and a conservative estimate in the month of July came to the conclusion that 700,000 tons could safely be expected. As the country itself consumes about 300,000 tons, there would then be a surplus of 400,000 tons, which, together with the existing final stock from the 1918-19 campaign, might allow a good exportation to other countries in exchange for cotton, leather, food, wheat, etc. But the early frost of November hindered the digging of the roots and hampered the transport to the factories, which could not work regularly and had to stop every now and then. It is believed that no less than 70,000 tons of coal was wasted in these circumstances, a misfortune that in the present time of scarcity is doubly awkward. In order to produce as much sugar as possible and to have an article of high value to serve for barter, every effort was made to get the frozen and thawed beets to the sugar factories, but transportation was so bad that this plan failed. The total sugar production of Czecho-Slovakia will not now exceed 550,000 tons. On January 1st there were no more than 79,000 tons of refined sugar available while the sales to other countries, already contracted for, amounted to 430,000 tons. It is certain that after January yet further amounts of sugar will be produced, but the optimistic hopes fostered in the late summer have been greatly thwarted by the coal scarcity, in this case aggravated by an early cold wave in November.

It is said that the republic of Austria will not produce more than 5000 tons of sugar this season, while the republic of Hungary is not much better off, having produced something over 30,000 tons.

We hear that the Russian sugar factories which might do work are completely out of coal supplies. The most favoured factories were supplied with 50 per cent. of their requirements of fuel in the shape of firewood, but as the transport of that bulky material from the forests was only achieved under difficulties, it is not certain that the other half will be supplied in time.

Fortunately the Western European countries, Belgium, Holland, France, as well as Denmark and Sweden, have not to deal with the same troubles arising from the want of fuel. Coal is expensive in those countries and none too abundant in most of them, but they do manage to get it, and their sugar production, at any rate, has not suffered from want of fuel.

Clarification in White Sugar Manufacture in Natal.

By WILLIAM CLACHER.

In this article a description will be given of the method of working adopted in some of the factories in Natal, it being the object of the writer to convey a general impression, rather than a precise and detailed account of the processes followed. Essentially, the procedure of white sugar manufacture in Natal is the same as that practised in Mauritius, differing only in detail due to the different nature of the variety of cane crushed.

There is of course a radical difference between the methods of preparing juice and syrup for cargo sugar and for white sugar. In the latter the appearance is the principal factor, its keeping quality in these days of rapid sale and immediate consumption not being so important. With proper treatment a good white sugar may be made from a juice having a low quotient of purity 70° or under; while, on the other hand, it is not difficult to make a poor grade of white sugar from high quotient juice. In raw sugar manufacture mistakes in defecation which may affect colour and appearance might not make any difference in financial return. In white sugar manufacture, on the other hand, extreme care throughout is all important.

Juice clarification.—Generally the custom in Natal is to sulphur the juice prior to liming, although a few mills lime before sulphuring. Sulphur boxes are used only in raw sugar factories, while for plantation white manufacture sulphuring tanks, 2 to 6 in number, are employed, the gas being injected either by compressed air or with steam. As the juice leaves the last tank, its sulphur dioxide content varies from 1 to 2 grms. per litre, and at least 1 grm. per litre is considered essential for good plantation white sugar when made from the Uba cane.

Following sulphitation the juice is limed in the cold, and in some factories phosphoric acid in requisite amount is added. Juice thus prepared is passed through heaters, or raised to "cracking point" in defecators and settled, the final treatment being made just before cracking by the addition of more lime or phosphoric acid, as conditions demand. It is not the custom to use carbonate of soda or other precipitant of lime. As a general rule, juice which is acid in reaction (due to sulphurous acid) when it is passed through the heaters will give a better white sugar than when its reaction is neutral.

Frequent precipitations appear to tend to make a superior juice, since each precipitation carries with it some colloidal colouring or gummy matter. Thus acidifying, liming to excess, adding phosphoric acid, neutralizing with filter-press juice, and (if need be) phosphating the syrup, will give a higher yield of sugar than a single precipitation. It is probable that the gummy substances thus thrown down are the very bodies causing the sugars to be "off colour" and to store badly In fact, the difference between juice for white and for raw sugar manufacture consists altogether in the content of these colloidal substances.

Defecators, invented by Messrs. Hawksworth and Sons of the Beneva Estate, are in use in a number of mills. These are hemispherical bottomed copper vessels, which are steam-jacketed, and generally three in number. The juice flows successively from the first into the second and into the third, the temperature increasing as the juice passes on. The waxy scum arising does not go through the juice heater, a very great advantage.

Syrup preparation.—In most mills the syrup treatment consists simply in settling it. When the clarification of the juice has been efficient, a suitable syrup for white sugar manufacture is thus obtained. When, as often happens, the over-limed filter-press juice is mixed with decanted juice (probably under-limed) prior to going to the triple, a precipitation of gums naturally follows. This insoluble matter requires to be separated by settling.

In white sugar manufacture, the syrup must be brilliant. Opalescence or cloudiness in an otherwise well prepared syrup will give an "off colour" sugar, and even a slight fluorescence due to acidity is not good. A brilliant juice, not excessively acid, of the transparency of olive oil, is good for white table sugar manufacture. Phosphoric acid appears to be essential for the production of a brilliant syrup in the case of juice obtained from the Uba cane, and some factories in Natal are stated to spend a considerable sum upon this clarifying agent.

Colouring substances.—Certain authorities have pointed out that a certain amount of pigment is found in the rind of the cane. On examining the Uba cane, the writer observed that the rose pink matter occurring on a certain percentage of this cane gives a yellowish colour when treated with an alkaline solution. An interesting point is that since this pigment is more soluble in alkaline than in acid solution, it would seem to follow that sulphuring the juice previous to liming is preferable.

By far the most inimical colouring matter is a very minute proportion of black deposit which may completely spoil a strike by being incorporated with the grain, even though the syrup may be quite brilliant to all appearance. The importance, therefore, of clear syrup, free from the faintest trace of black sediment, cannot be overestimated.

When working with cane that is under or over ripe, or has fermented or become attacked by fungus, another deposit may occur, not in the syrup, but in the grain of the sugar. This deposit consists of calcium sulphite. Since lime salts are white, they do not materially detract from the appearance of the product, although if much be present only very fine grained sugar can be boiled. Probably the storing qualities of such sugar are not so good as that normally produced.

It is quite a custom in some mills when crushing cane that has fermented, or has become attacked by fungus, to lime very heavily. In this way a good sugar is produced, but the yield is poor, while the writer has known a first cuite resulting from juice thus overlimed to foam over within 12 hours of striking. There can be no doubt that this was caused by the decomposition of the lime salts of "glucose," probably calcium levulosate. In the particular instance in mind, the cane must have been cut at least 12 days previous to crushing.

Phosphoric acid drawn into the pan with sodium hydrosulphite gives a very white sugar, but the keeping quality of goods made with the latter reagent is often doubted.

Sucrate of lime defecation.—Among the advantages of defecating with sucrate of lime as compared with milk-of-lime are economy in lime and sulphur.[1]

A clear solution of calcium sucrate is prepared from juice and milk-of-lime. At Esperanza, Trinidad, with Barbados seedling cane the process worked admirably, giving a good clear "flat" juice without the slightest difficulty in filtration. The gums were all removed, and the syrup worked well in the pan.

At Reunion, Natal, however, there was greater difficulty in making the sucrate, and consequently the results were very variable. In fact, in this case it must be admitted that the treatment was a failure, particularly for plantation white manufacture. Subsequent experience showed that Uba cane juice can be defecated with clear sucrate of lime, giving a good recovery, but that certain precautions would require to be taken such as: (*a*) preparing the sucrate to a standard strength; (*b*) altering the filter-press work to cope with sticky scum; (*c*) making the juice brilliant as well as flat (say by the addition of some such reagent as aluminium powder); and (*d*) rendering the procedure as automatic as possible, in order to give little extra trouble to the labour.

There is not the slighest doubt that sucrate of lime is in many instances much to be preferred to milk-of-lime. It gives a higher yield of sugar and a better product.

A good standard strength of sucrate would be 20 grms. of calcium hydroxide per litre. With slow sulphitation and the use of sucrate, but little lime is brought into solution.

Filter-press work.—As a general rule, the scums in Natal mills are difficult to treat. Filtration is often unsuccessful or difficult unless an excessive quantity of lime be added, and in many small mills this is the common practice. At Reunion estate an experiment showed that finely divided coral lime added to the scums gave a good filtering cake. At Isezela (Reynolds Bros.), trials with centrifugal clarification are stated to have been successful.

Treatment of massecuite.—In most mills the cuite whether made from syrup alone, or from syrup with first and second molasses is double cured. Sugar resulting from the second curing is washed with a little blue water, and steamed.

It is not usual to grist the sugars, and the marketable grain of sugar in Natal is small. Natal first grade plantation sugar is usually quite white in appearance, keeping without sweating under reasonable conditions for at least six months. That from the best mills will compare with first refined in appearance, although it will not store so long. The second and third whites are not quite this standard.

Molasses treatment.—Generally the molasses is diluted to 25° Bé., limed with a small portion of milk, sulphured and settled for some hours. In some cases sulphurous water is used; while in others the gas is blown in with steam or air. The use of phosphoric acid at this stage is usually avoided as it is inclined to make the massecuite sticky and difficult to cure. That is so at any rate in the case of Uba cane juice.

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[1] See also *I.S.J.*, 1919, 523.

A Short History of the Japanese Sugar Industry.[1]

By TARO OBANAWA.

So far as is known, sugar was introduced into Japan about 1160 years ago following the visit of some Hindu priests. It was not until much later, however, about 230 years ago, that some cane cuttings were brought back by a native of Oshima whose vessel had been driven to South China by a storm. These cuttings were planted on the island of Oshima and from them grew the first cane crop Japan used in the production of sugar. Cane had been grown in the Loochoo Islands for many years before this time but no sugar was made therefrom, the natives eating the cane as they would eat fruit. But after the introduction of cane into Oshima, sugar was manufactured with considerable energy there, and, after 1615, in the Loochoos, whence the practice gradually spread to other parts of Japan. During the feudal period the manufacture of sugar was greatly encouraged, and the industry developed not a little through the fact that various clans were often engaged in keen competition, the greatest fame being gained by the Takamatsu clan, which became known as the producer of "Sanuki" sugar, a pure white sugar popularly known as "Sambon White." In the Bonin Islands sugar cane was first introduced by a whaler, which brought the cuttings from either South China or Hawaii.

Climatic conditions in Japan, except in the Loochoos, however proved unfavourable to the cultivation of cane. When the protection given by the clans ceased at the time of the Restoration in 1868, the industry gradually waned, with the consequence that home production could not meet the demand, and importation of sugar from Formosa, which was at that time under Chinese rule, and from the Philippines and Europe became of great importance as a factor in the Japanese sugar market. This condition was aggravated through the fact that consumption increased rapidly. About 1894 Japan consumed some 300,000 tons a year, of which approximately 65,000 tons were produced in the Loochoos, Oshima, Kyushu, Shikoku, the Bonins and in some parts of Honshu, the main island, the remaining 235,000 tons required being imported at a cost of about $10,000,000 a year. This condition was of sufficient importance in national economic life to cause considerable anxiety to the Government authorities and others interested. The necessity of working out some policy whereby it could be corrected was being considered, when at this very opportune time Japan obtained Formosa as a result of her victory in the Chino-Japanese War of 1894-95.

Sugar was first planted in Formosa during the early part of the sixteenth century by some Chinese immigrants. The industry was greatly developed when the island subsequently passed under Dutch rule, about 285 years ago, and the production was gradually brought up to 100,000 tons a year. It was, however, not particularly prosperous at the time when Formosa was acquired by Japan, as it had suffered from adverse weather conditions and insurrections, and when to this was added the return to China of the Chinese capitalists who had been engaged in the industry, the production fell to about 30,000 tons.

To Japan, nevertheless, the acquisition of this sugar producing country came as a solution of the great problem with which she had been struggling for years, and no time was lost in taking advantage of it. Under the protection of the Government-General of Formosa, certain influential capitalists connected with the

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[1] Slightly abridged from an article in the *Trans-Pacific*, Tokio (Vol. 1, No. 4, 13). Mr. OBANAWA was for 20 years connected with the Sugar Administration Bureau of Formosa, first as chief expert, and later as acting director. He is considered one of the best Japanese authorities on the sugar industry.

Mitsui Company established, in 1900, a sugar manufacturing company, the Taiwan Sugar Company, Ltd., with a capital of $500,000. A factory having a cane crushing capacity of 200 tons in 24 hours was erected at Kyoshito, this being the first modern sugar mill established in Formosa, and in 1902 this mill began active operations.

The men behind the Taiwan Sugar Company, as well as those who followed them, were greatly benefited by the encouragement the Government extended to them in various ways. One of the most important of these was the close study which the authorities caused to be made of means for the improvement of the methods used both in the cultivation and in the manufacture of the product. The first result of these studies under the auspices of the Government was the importation from Hawaii of some cane cuttings of superior varieties, and from this beginning may be dated the present prosperity of the Formosan sugar industry, another very important factor being the promulgation of the Sugar Consumption Tax in 1901. Particular attention was given the sugar industry by the late General KODAMA, when he was Governor-General, and by Baron GOTO, who was then chief of the Civil Administration Bureau. These men made strenuous attempts to bring back the sugar industry from the reduced circumstances into which it had sunk on account of various adverse factors, and with this end in view they sent for Dr. INAZO NITOBE of Sappora Agricultural College, appointing him Chief of the Industries Bureau in 1901 and requesting him to make a thorough investigation of the entire island.

Examination of the possibilities of Formosa as a sugar producing country impressed Dr. NITOBE greatly. His report, submitted a few months later, made a large number of suggestions which have proved to be of the utmost value. Dr. NITOBE outlined a comprehensive plan to be carried out during a ten-year period. Among his numerous recommendations were : Improvement of the canes by importation of better varieties from other sugar-producing countries, introduction of a more intensive method of cultivation, establishing of a model farm to demonstrate to the farmers the advantages of improved methods, increase of the yield by use of artificial irrigation, conversion into cane fields of paddy fields suffering from lack of sufficient irrigation, reclamation of waste land suitable for cane cultivation, improvement of manufacturing methods by introduction of modern machinery, revision of the customs tariff, enactment of a tax refunding law in respect to sugar used in the manufacture of condensed milk and confectionery, improvement of traffic conditions, extension of sugar markets, official fixing of prices of cane, providing of special education in connexion with various branches of the industry, encouragement of associations of sugar manufacturers, enactment of a law providing for the insurance of cane, protection and increase of live stock, and study of the use of various by-products of sugar. He concluded that it was his belief that in case a programme based on these recommendations should be adopted, the sugar production of Formosa might be increased to a minimum of 120,000 and a maximum of 240,000 tons.

The general recommendations outlined above were crystallized by Dr. NITOBE in the memorial for the enactment of a " Law for the Encouragement of the Sugar Industry " and another measure providing for the organization of "The Temporary Sugar Bureau of Formosa." In connexion with the latter, he recommended that the Government establish at Tainan, one of the most important sugar producing centres, a branch bureau at which experts could be trained and where an experimental farm could be conducted, using largely canes imported from Hawaii, and where a nursery of such could be maintained, whence cuttings of superior varieties might be distributed to the plantations in various districts. This bureau should also maintain an experimental department dealing with the manufacture of sugar and should encourage the organization of associations whereby those engaged in the industry might increase their profits, promote their common interests and make arrangements for the most advantageous use of water employed for the irrigation of cane fields. This bureau should also furnish information which might lead to the investment of private capital in sugar producing enterprises.

The value and importance of Dr. Nitobe's report were readily appreciated by General KODAMA and Baron GOTO, and they worked out a budget based thereon, which was passed by the Imperial Diet. In June of the following year, 1902, the Regulations for the Encouragement of the Sugar Industry in Formosa and the law providing for the organization of the Temporary Formosan Sugar Bureau were promulgated. These marked the inception of the present prosperity of the industry.

One of the most important features of the new regulations was the granting of bounties to persons engaged in the planting of sugar cane or in the manufacture of sugar, provided that the Government-General of Formosa recognized such as being deserving of its support. These bounties were granted for the specific purpose of meeting expenses involved in purchasing fertilizers and sugar manufacturing machinery, in the reclamation and drainage of land, and in making similar improvements. In 1905 the Regulations for the Control of Sugar Manufacture were promulgated, providing that all persons who wished to establish sugar factories using new machinery entirely or in part should apply for permission to do so to the Government-General. Upon receipt of such permission, the location or extension of the cane farms supplying the raw material would be determined in accordance with the new mill's capacity. Erection of factories of the old style was prohibited in the area controlled by the new plant, nor could cane grown therein be used for any purpose other than sugar manufacture. On the whole the regulations proved a strong safeguard for the new factories, as they ensured a sufficient quantity of proper raw material.

The Government-General installed an experimental station at Daimoko, in South Formosa, which served the double purpose of making various investigations and studies covering both the agricultural and the manufacturing sides of the industry, and training experts in the sugar business, this latter being done by means of a school attached to the station. A cane nursery was also maintained in which cuttings of superior varieties were grown for distribution to the various plantations. At Takao an inspecting office was established where the quality of sugar samples was determined by means of chemical analysis and where general laboratory work was carried out on products connected with the industry. The Government-General thus faithfully followed out the scheme outlined by Dr. NITOBE, with the very gratifying result that when the ten-year period had passed, namely in 1911, the industry had not only reached, but had passed, the mark set out by Dr. NITOBE. The acreage under cane increased from 65,000 to 225,000 acres, while the total sugar production mounted from about 50,000 to over 300,000 tons.

This advance is emphasized by the fact that while 20 years ago 10 tons of cane per acre was considered a fair crop, the best fields, cultivated in accordance with improved methods, now produce 20 tons to the acre, truly not a very large crop when compared with those produced in many other sugar producing countries, but, nevertheless, a great improvement. In the best mills 100 tons of cane produce 12 tons of sugar.

This great reconstruction was the result of the policy of the Government-General so to encourage the industry that capital would seek therein a profitable field for investment. As early as 1902 an increasing number of Japanese capitalists began to turn their attention to Formosa, and the industry was later stimulated by the economic boom following the conclusion of peace between Japan and Russia. One sugar company after another was established, and in 1911 the total of large and small ones had reached 29. The progress of the industry had, however, been attended with some difficulties, the most serious of which was the severe weather prevailing in Formosa almost every autumn. In 1911 and 1912 there were particularly destructive storms, the worst which had visited the island for a half century. Damage to crops and mills was enormous, and all companies were brought to the brink of disaster, as will readily be seen from the fact that sugar production in 1913 had fallen to only 80,000 tons. This made a profound impression on the public mind, and general opinion concerning Formosa's sugar industry became quite pessimistic. The sugar companies, however, put up a gallant struggle in their time of adversity, and their business now appears to have been fully restored. Numerous changes have taken place, many of the smaller concerns having been bought out or merged with other concerns, with the result that the number of companies has decreased, while the number of factories and their manufacturing capacity have increased. The following table gives a list of the factories, the capacity in tons of cane crushed per 24 hours and other details:—

COMPANY.	PAID-UP CAPITAL. $	CAPACITY TONS.	KINDS OF FACTORIES Raw.	Refined.	Alcohol	DIVIDEND. PER CENT.
Taiwan	10,417,500	8,690	10	2	2	26
Dai Nippon	7,112,500	2,440	2	3	—	50
Tainan	6,187,500	910	4	—	—	12
Teikoku	5,250,000	2,350	5	1	1	25
Toyo	5,055,000	3,910	6	1*	—	30
Meiji	4,462,500	3,770	4	2	1	22
Ensuiko	5,625,000	4,390	5	2*	—	20
Niitaka	2,500,000	2,170	2	1	1	22
Taito	1,575,000	560	2	—	—	8
Linhongen	750,000	830	1	—	—	30
Shinko	300,000	560	1	—	—	20
Total	$49,235,000	30,580	42	12	5	—

In addition to these, two new raw sugar companies are now in process of organization. The capital of one of these will amount to $3,750,000 and that of the other is yet unknown.

The following table shows, in approximate figures, the areas of cane plantations throughout Japan and the sugar production according to the latest returns:—

	ACRES.	LBS.
Formosa	262,500	730,000,000
Loochoo	25,500	68,510,000
Oshima	12,500	27,850,000
Kyushu	5,600	17,350,000
Shikoku	3,700	13,150,000
Bonins	2,000	3,000,000
Honshu	1,400	2,600,000

While the industry in Formosa thus far overshadows the sugar production of other sections of the Japanese Empire, the manufacture of sugar from beets has been carried on for some time and has attained some measure of success. The first trial planting of beets was made in 1873 in Hokkaido, seed having been brought from Europe. The result appeared to be rather satisfactory. In 1876 trial plantings were made in the north-eastern part of Japan, but these were not successful. In 1879 the Government imported machinery from France, which was installed in a factory in Hokkaido, this being the first beet sugar mill erected in Japan. This was followed by the forming, in 1887, of a sugar manufacturing company, the Sapporo Sugar Company, which imported machinery from Germany and also brought a number of German experts to Japan. The capacity of the company's factory at Sapporo was 200 tons of beet in 24 hours. Neither of the two factories mentioned met with success, however, and both were finally forced to cease operations. Recently renewed experiments have been made, whereby a group of powerful capitalists has been encouraged in forming a new beet sugar manufacturing corporation, under the name of the Hokkaido Sugar Company, Ltd., with a capital of $5,000,000. This corporation has obtained 15,000 acres of land suitable for beet cultivation, and has erected a modern factory and placed it in charge of sugar men from Formosa, whose experience is expected to prove a valuable aid.

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* Raw as well as refined.

A beet sugar producing company, with a capital of $5,000,000, with a factory at Mukden, has been operating for some time in South Manchuria. It has already reported on its results for two terms, and it appears that the venture has been entirely successful. A company was also formed for the purpose of engaging in the manufacture of beet sugar in Korea. The capital of this concern is $2,500,000, but it was later amalgamated with the Nippon Sugar Company, Ltd., one of the largest sugar concerns in Japan.

During the period in and about 1897 a number of sugar refining companies were established in various parts of Japan, but they operated on a small scale and were driven out of existence by the overwhelming influence of foreign sugar, a few only managing to eke out an existence through tariff protection. The few companies which thus survived the depression were either bought up or amalgamated when conditions following the Russo-Japanese war favoured development of the industry. Later, when another tariff revision produced still more favourable circumstances, three or four new sugar refining companies arose, but these also were either bought out or dissolved, leaving no corporation exclusively engaged in the refining business. The Nippon Company, which has a raw sugar factory in Formosa, also has a refinery in the interior of that island. Its daily refining capacity is 700 tons, which makes it the largest plant of its kind in Japan. Four other raw sugar manufacturing companies, namely, the Meiji, the Taiwan, the Niikata, and the Teikoku, also operate refining plants, that of the Taiwan being the second largest in the country. Three mills manufacture plantation white sugar as one of their products, these being the Ensuiko, the Toyo, and the Taiwan, the first mentioned having met with considerable success in this business. In addition to these established concerns, another refining company is at present in the process of organization. It will operate in Japan, with factories at Tokyo and at Nagoya.

Besides these plants, some old-style factories carry on the production of muscovado, their total capacity per 24 hours being about 9000 tons, and their total capital about $4,500,000. Two Japanese companies operate in Java. One, the Nankoku Sangyo Company, Ltd., with a capital of $2,500,000, has a capacity of 500 tons per 24 hours, while the other, Nanyo Sugar Company, Ltd., capitalized for a like amount, operates a mill of 400 tons capacity.

The total sugar consumption of Japan is approximately 500,000 tons annually, or about 16¼ lbs. per head. This is a great increase for Japan, though it is low in comparison with other countries.

In 1917 Formosa's cane acreage was 320,000, producing over 440,000 tons of sugar, in addition to which over 80,000 tons were produced elsewhere in the Empire. This not only provided for the home consumption, but allowed exportation of a surplus. Last year and this have shown decreased productions, though consumption has risen owing to increase in population and also to development of condensed milk and confectionery manufacturing industries. The result has been that supply has fallen short of demand. The problem of bringing up the production to the point where it will meet the increased demand can, of course, be solved only by enlarging the crops of sugar cane in Formosa and of beets in Hokkaido, Korea, and South Manchuria. In considering the former phase of the problem, a comparison between conditions in Formosa and those prevailing in Hawaii and Java reveals the fact that while Formosa does not show badly as far as manufacturing methods are concerned, she is far behind in the purely agricultural phase of the industry. In view of this, it is evident that the central Government should first of all encourage planters to improve their methods of cultivation, largely by selection of the best varieties of cuttings.

A great step in this direction is being taken by the Sugar Experiment Station, where experiments and investigations are being carried on for the purpose of determining which varieties of cane are best suited for the conditions prevailing in Formosa, in selecting fertilizers best adapted for various localities and in fighting insect pests. The aim is, of course, that of producing as great a quantity of cane per acre as possible, and while the standards of Hawaii, Java, and Cuba may not be attained, it should be possible to double the present rate of production. If 30 tons of cane per acre can be raised, this will be considered a very satisfactory result. There can be no fear of over-production as the demand in Japan is constantly growing, while the great market in China will be able to absorb any possible surplus.

Since the end of the war the world's sugar supply has become entirely insufficient, and the price of sugar has risen everywhere, especially that of the Java product. In the Japanese market it has doubled, the prices to-day per 100 lbs. being as follows: Muscovado, $12; brown granulated $12·50, and refined $15. Coming as it does with the great increase in the price of rice, this doubled cost forms a serious factor in the economic life of Japan.

The rapid development of the sugar industry in Japan caused considerable competition to arise among raw sugar manufacturers, which finally brought about organization of the "Taiwan Sugar Trade Union," whose object was to develop the trade and promote the members' mutual interests. Any company operating a raw sugar factory in Formosa or any individual interested is qualified for membership. This organization determines the amount of sugar to be sold by each of the companies under its jurisdiction and adjusts the prices of materials used for refining. It also takes active measures for the extension of markets abroad, and, as it represents a large number of powerful companies, it has become a very influential factor.

The history of Japan's sugar industry has been affected considerably by legislation, particularly by the sugar consumption tax and the tariff. Following the Chino-Japanese and the Russo-Japanese wars the consumption tax was in both cases raised considerably, especially after the latter, and the industry was in each case badly hampered because of the resulting decrease in consumption. The tax was in 1901, Y1 per 100 kin[1] for Dutch Standard up to No. 8 and on molasses; Y1·60, on Dutch standard up to No. 15; Y2·20 on Dutch Standard up to No. 20, and Y2·80 on Dutch Standard No. 20 and above, including candy sugar. A war tax of Y1 per 100 kin was added in 1904. The consumption tax is now as follows:

Dutch Standard up to No. 11—Class A, Y2; Class B, Y2·50; Class C, Y3.
Dutch Standard up to No. 15, Y5.
Dutch Standard up to No. 18, Y7.
Dutch Standard up to No. 21, Y8.
Dutch Standard above No. 21, Y9.
Candy sugar, loaf sugar and cube sugar, Y10.
Syrup, Y8.
Molasses, ranging from Y2 to Y3.

The industry has, on the other hand, profited considerably by the import duties which have gradually increased and which since April, 1911, have stood as follows: Dutch Standard up to No. 8, Y2·50; up to No. 15, Y3·10; up to No. 18, Y3·35; up to No. 20, Y4·25; above No. 20, Y4·65; candy, cube and loaf sugar, Y7·40; molasses, Y1·30 to Y2·50; syrup in bottles, Y15·30; other syrup, Y10·70.

The exports and imports of sugar since 1913 have been as follows, according to foreign trade reports of the Department of Finance:

	EXPORTS.		IMPORTS.	
	QUANTITIES. KIN.[1]	VALUES.	QUANTITIES. PICULS.[2]	VALUES.
1913	168,766,922	Y15,831,330	5,436,596	Y36,752,050
1914	131,263,331	12,382,809	3,309,549	21,678,634
1915	116,508,075	11,803,785	2,077,210	14,805,094
1916	146,193,769	16,421,738	1,600,857	12,978,056
1917	220,903,954	26,151,491	1,316,024	11,697,273
1918	190,878,168	23,252,186	3,725,387	33,525,453

During the first six months of 1919 imports amounted to 2,136,324 piculs, valued at Y21,027,690, and exports, 63,174,296 kin, valued at Y7,997,723. Normally the chief destinations of Japanese sugar exports are China, Kwantung Province, British India, and Asiatic Russia; while sugar is imported chiefly from China, Hong Kong, Java, and the Philippines. China takes the vast bulk of the exports while Java sugar is the principal import.

It has been attempted here to give a general survey of the entire sugar industry throughout the Japanese Empire, and while it has been shown that grea difficulties have been overcome, it is also evident that there are still many obstacles lying in the way of complete success, that many problems must be solved before the industry of Japan, or at least that of Formosa, can rank with those of older sugar producing countries. The Government should, therefore, determine on a policy which may carry the industry further along the road towards success. The entire farm area of Formosa now covers a total of about 1,800,000 acres, of which approximately 15 per cent. is cultivated in cane. This area can hardly be increased, as, if this is done, a shortage of other food supplies may result. It is obvious, then, that the present crop average of 15 tons to the acre must be increased. Improved seed and the use of fertilizers must be resorted to, and in carrying out this plan the Government must take an active part by framing and enforcing a protective policy based on the results of an investigation of the conditions prevailing all over the world in connexion with the sugar question. I outline below three propositions which I think may solve the problem, and I hope that one of them may appeal to the authorities:

1. The enforcement of a law whereby farmers are compelled to plant according to certain stipulated conditions, the increase in the profits resulting from this procedure being shared equally by the company and the farmers.

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[1] A kin equals 1⅓ lbs.

[2] A picul equals 133⅓ lbs., or 100 kin. It is not uncommon to find different units of measurement used in the same tables in Japanese statistical reports.

2. The enforcement of a law providing for a sugar monopoly which may encourage the farmers to increase their cane crops and which will provide for the insurance of crops.
3. The enforcement of a law whereby the Government will conduct the entire sugar business, laying special stress on improvement of farms and insurance of crops.

Data relating to the Standard Capacity of Sugar Factory Plant.[1]

By W. v. H. DUKER.

Three years ago a circular was sent out by the Hawaiian Engineers' Association to factory engineers asking for data and capacities of mill and boiling-houses. It became clear that where the question of sufficient capacities was under discussion, nobody but those directly in charge of the boiling-house could give a proper opinion. Thus the co-operation of the Hawaiian Chemists' Association was sought for. A committee was appointed, and the capacities of the various stations were calculated from a number of factories and presented to the Association last year.

The following is a list of capacity data established several years ago by Mr. HORACE JOHNSON:—

		Sq. ft per ton cane per hour.
Juice heaters		30
Evaporators	Triple effect	215
	Quadruple effect	290
Pans		55
Centrifugals	1st	3
	2nd	4·5
Presses		120
		Cu. ft.
Settling tanks		72
Crystallizers		181·2
Tanks		181·2
Total		362·4
Coolers, 1st strike, 14 days		368·2
2nd ,, 60 ,,		1098·7
Total		1466·9

A copy of these data was sent to the members of the Association requesting them to give the capacity of their several stations alongside, and state their opinion of the matter generally.

Last year there was a discussion as to what would be the most desirable way of arriving at standard figures. Mr. H. S. WALKER proposed the following scheme:—

From the data obtained from the different mills a standard could be calculated. Such a standard mill is assumed to produce 100 per cent mixed juice on cane, mixed juice of 14° Brix and 85° purity, syrup of 65° Brix and commercial sugar of 97° purity. Having once established standard capacities for these fixed conditions, capacities for any individual mill would vary from the standard as follows:—

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[1] Summary of a paper entitled "Report of Committee on Standardization," presented to the 17th Annual Meeting of the Hawaiian Chemists' Association.

For each 1 per cent. mixed juice on cane above or below 100 per cent., increase or decrease all capacities by 1 per cent. For each degree above or below 14° Brix of mixed juice, decrease or increase evaporator capacity by 2 per cent.* For each degree above or below 14° Brix of mixed juice, increase or decrease capacities of pan, centrifugals and storage 7 per cent.† For each degree above or below 85 purity of mixed juice, decrease or increase capacity of crystallizers and low grade centrifugals by 8·5 per cent.‡

The total pan capacity depends on the weight of solids to be handled, i.e., on the Brix of mixed juice. It should not vary with purity, though the relative capacity needed for high and low grade strikes does vary. As all the sugar eventually enters the No. 1 centrifugals, their capacity should not vary with purity, but only with the Brix of mixed juice.

As an example of the above method of calculation, take a factory producing 120 per cent. mixed juice in cane of 10° Brix and 75° purity; its capacity per ton cane per hour should then be: Juice heaters and settling = standard × 1·2; evaporators = standard × 1·2 × 1·08; syrup tanks, pans and No. 1 centrifugals = standard × 1·2 × 0·72; crystallizers and low-grade centrifugals = standard × 1·2 × 0·72 × 1·85.

In the following table are given some of the data relating to the capacity of factory plant, that were presented to the Committee :—

	Hawaiian C. & S. Co	Oahu Sugar Co	Pioneer Mill Co.	McBryde Sugar Co.	Koloa Sugar Co.	Union Mill Co	Java Factory built 1917
Cane ground in tons per hour	130	100	70	40	35	20	55
Juice heaters, sq. ft. H. S.	42	31	31	43	30	30	55
Evaporators, sq. ft. H. S.—							
Triple	—	—	—	—	—	304	322
Quadruple	197	350	240	352	260	—	—
Pans—							
Sq. ft. H. S.	52·5	40	53	64	46	18·3	93
Units	6	3	3	3	3	2	4
Centrifugals—							
Sq. ft. screen area—1st	1·6	1·8	3·0	3·1	3·5	4·7	12·3
2nd	4·5	3·1	3·9	5·2	4·1	—	—
Presses—							
Sq. ft. filtering area	80	84	69	124	96	98	—
Settling tanks, cub. ft.	83·5	71	82	81	51	77	77
Low grades storage	—	—	—	305	—	—	—
Crystallizers	276	180	204	—	195	—	134
Tanks	880	320	—	1000	102	505	—
Total	1156	500	—	1305	297	—	—

Mr. Wm. Searby wrote to say that the capacities that seemed advisable were: juice heaters, 35 sq. ft.; quadruple, 300; triple, 215; pans, 60; first centrifugals, 2·5; and second centrifugals, 5·0 sq. ft. In the case of the other apparatus, the values he suggested were the same as those proposed by Mr. Johnson. This increase in the heating surface of the heaters and evaporators was recommended to deal with the increased amount of maceration now being used with higher extractions; while that of pans was advised since it permits the use of steam of lower pressure for boiling, and provides the adequate pan capacity in order to obtain the lowest practicable gravity purity in the waste molasses.

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* $\frac{1}{65} \div \frac{51}{65} = 1·96$ per cent.

† $1 \div 14$

‡ $\frac{1}{42} \div \frac{42}{42}$

Mr. W. K. Orth stated that he preferred 290 sq. ft. H. S. for a quadruple, considering it to be ample under all conditions. In the case of the pans, he finds 46 sq. ft. to be sufficient, provided there are 3 units, of which 2 are heated with live steam, and the other with exhaust. Under his conditions he would advise 2·8 and 4·8 sq. ft. for the first and second centrifugals; while 60 cub. ft. would suffice for settling tanks. The capacity stated by Mr. Johnson for the mud presses would be right. The average purity of the syrup in his factory is 81·4°.

Mr. G. Giacometti sent a contribution, in which he stated that the capacity data for his mill grinding 50 tons of cane are very close to the so-called "standard" values, being ample for his conditions of work. When, however, he is grinding at the rate of 65-70 tons per hour, the work (except at the heaters and evaporators) depends absolutely on the sucrose per cent. in the cane and the purity of the syrup. This goes to show that that it is not possible to set "standards per ton of cane," since there is cane *and* cane. He has calculated that if a certain plant is sufficient for 70 tons of cane per hour with syrup of 88° purity in order to handle the low products with the same equipment, the tonnage must be lowered to 40 tons when the purity drops to 82°. Must the values be based on a high or on a low purity? Or on an average one, say of 86°, so that when the purity drops to 82° the manager is asked to slow down the mill and the rest of the plantation? In the following table are given the tons of first molasses of 85·5° Brix and 56·0° purity for boiling into low grade per day which result when the rate of 40-70 tons of cane per hour with 13·00 per cent. of sucrose, 97 per cent. extraction, and juice purities from 82 to 88°:—

Purity of Juice	Tons of Cane per Hour			
	40	50	60	70
88	36·81	46·02	53·14	64·43
86	45·39	56·73	68·08	79·44
84	54·49	68·09	81·71	95·33
82	64·31	80·39	96·46	112·54

Mr. J. P. Foster, replying to a circular letter of enquiry sent him, said that in his opinion the standardization figures should be handled with a good deal of caution. Values eminently satisfactory in one factory would be entirely out of place in another, due to the difference in the purity of the cane handled, and to the methods of working in the factory. This is plainly demonstrated in his factory at Paia. For example, the H. S. in the boiling house has been designed with a view to utilizing low pressure steam exclusively, taking for that purpose the exhaust steam of an electric generator station operating in conjunction with the mill. This station takes in fact the steam which is intended for use in the boiling house, expands it to 1 to 3 lbs. pressure, passes it on to the heating system of the boiling house, and delivers to the electric irrigating pumps a large amount of current which he terms "by-product power," Thus, factors foreign to ordinary practice are introduced. His rate of grinding varies widely from 60 to 75 tons, and the capacities for these two figures respectively are found to be in the case of the heaters (3701 sq. ft. H. S.), 50 to 60 sq. ft. per ton of cane per hour; in that of the quadruple (26,000 sq. ft.), 346 to 433; and in that of the pan (9937 sq. ft.), 132 to 166. It is observed that these figures are 100 to 200 per cent. higher than those of Mr. Johnson, but they are found very satisfactory, and permit the operation of these three stations at practically atmospheric pressure. A different condition obtains as regard to centrifugal capacity. No. 1 centrifugals have 126 sq. ft., or 1·7 to 2·1 t. c. h.; and No. 2, 217·3 or 2·9 to 3·6. These values give good results, the material operated upon being of a very high purity. With regard to the filter-press station, satisfactory service is obtained from a total of 3200 sq. ft., or

42·6 to 53.3 t. c. h. But filtering area is an erroneous standard for filter-press work. It should be based upon the mud capacity of the press. As to the crystallizer capacity, this is 3306 cub. ft., or 448 to 560 cub. ft. per t. c. h. There are no tanks or coolers in his factory.

Mr. H. S. WALKER, of the Pioneer Mill Co., gave his method of calculating from "local" to "normal" conditions, the recommended values in the case of his factory being, heaters, 31; quadruple, 280; pans, 55; No. 1 centrifugals, 3; No. 2 centrifugals, 5; presses, 70; settling tanks, 82; crystallizers, 250. His calculations were based upon the following data:—

	PIONEER FACTORY	NORMAL FACTORY
Mixed juice per cent. cane (highest week's run)	120	100
Brix of the mixed juice (highest week's run)	16·8	14
Ditto (lowest week's run)	11·8	14
Purity of the syrup (lowest 4 week's run)	84·5	85

Juice heaters: Divide the local value by the mixed juice per cent. cane, *e.g.*, $31 \div \frac{120}{100} = 26$. Quadruple: Divide local value by the mixed juice per cent. cane plus 2 per cent. for each Brix degree of the lowest mixed juice below the "normal" value: *e.g.*, $120 + (2·8 \times 7) = 139·6$. Pans: $55 \div \frac{139·6}{100} = 40·0$. No. 1 centrifugals: same as for pans; *e.g.*, $3 \div \frac{139·6}{100} = 2·2$. No. 2 centrifugals: Divide local value by mixed juice per cent. cane plus 7 per cent. for each Brix degree of highest mixed juice above normal, plus 8·5 for each degree purity of the lowest syrup below the normal; *e.g.*, $120 + (2·8 \times 7) + (0·5 \times 8·5) = 143·8$; $5 \div 143·8 = 3·5$. Settling tanks: Same calculation as for heaters; *e.g.*, $82 \div 120 = 68$. Crystallizers: Same as for No. 2 centrifugals, *e.g.*, $250 \div 143·8 = 175$.

Having established the standard of capacity for the normal mill, that for one working under different conditions may be calculated in the reverse way to that followed above. For instance, assuming that the capacity of the normal mill already stated had been decided upon, what would be the values for a mill making 130 per cent. mixed juice on the cane, the highest Brix of the mixed juice being 16·0, the lowest, 10·0, and the lowest purity of the syrup 78·0? Heaters: $26 \times \frac{130}{100} = 34$ sq. ft. Evaporators: $225 \times \frac{(130 + 8)}{100} = 312$ sq. ft. Pans: $40 \times \frac{(130 + 14)}{100} = 52$. Centrifugals No. 1: $2·2 \times 144 = 3·2$. No. 2 Centrifugals: $3·5 \times \frac{130 + 14 + 59·5)}{100} = 7·1$. Settling tanks: $68 \times 130 = 88$ cub. ft. Crystallizers: $175 \times 203·5 = 356$ cub. ft. The considerable difference between some of these latter figures and those given for the Pioneer Mill and for a normal factory will be noticed. It would be found very difficult to give due weight to the recommended capacities from different mills unless some such method of reducing them to a common basis is used.

From the data presented it becomes clear that the question of adopting standards for boiling-house equipment has not become any less complicated. In fact, it will always remain a difficult task, because conditions vary so much.

Report on the Curing and Marketing of Raw Sugars in Hawaii.

Maintaining the polarization at 96°. Use of automatic dischargers. Advantages of cooling and drying raw sugars. Value of automatic weighing machines. Size of bag. Improving the centrifuging of low grades.

The Committee on Curing and Marketing of Raw Sugars appointed by the Hawaiian Sugar Planters' Association, acting under the chairmanship of Mr. WM. LOUGHER, recently sent out a series of questions to factory superintendents in the Territory in order to elucidate general opinion upon certain important points. Their replies are here briefly summarized. This stage of manufacture was dealt with last year,[1] and Mr. LOUGHER comments that there still remains much to be done in the direction of devising and adopting methods for facilitating boiling and for improving the separation of molasses from the massecuites. It is questionable, he adds, whether this can be realized by a single method for general application in all the factories.

Question 1.—Which method, if any, have you used to keep the polarization of the sugars shipped at the most profitable point?

Mr. HERBERT S. WALKER replied that at the Pioneer Mill three grades of massecuites are boiled with high purity juices: (*a*) Straight syrup strike started on low-grade sugar seed, the average purity of the massecuite and molasses being 84·64 and 65·8° respectively, and the polarization of the sugar 96·94°. (*b*) The strike is started in the same way, and molasses from (*a*) is boiled in, the purity of the massecuite and molasses being 80·12 and 59·09°, and the polarization of the sugar 96·0°. (*c*) Again the strike is started in the same way as in (*a*), while molasses from (*b*) is boiled in, the purities being 77·21 and 55·5°, and the polarization of the sugar 95·22°. No molasses from this boiling is taken back, being all grained and boiled for the crystallizers. If the average polarization is higher than 96°, it is reduced by washing the straight syrup strike with just sufficient (*c*) molasses to displace the high purity molasses. On the other hand, when the juices are very low in purity, strike (*c*) may be washed in the centrifugals with a little water.

Messrs. S. C. SMITH and G. F. MURRAY replied that a massecuite of about 78° purity gives a sugar polarizing very close to 96° without washing. It may, however, also give a No. 1 molasses of 60–64° purity, which is too high to give a satisfactory waste molasses in two boilings. In this case, the purity of the first massecuite is reduced and the sugar is washed with hot water from the evaporators which is clean and sterile. Other replies were in the same sense.

Question 2.—What is your opinion of the use of automatic dischargers, particularly in regard to their behaviour with the larger grained sugars?

Mr. G. GIACOMETTI said that their value was still a matter of discussion. On the other hand, Mr. C. BUDDE stated that he has used Roberts-Gibson dischargers with machines treating both raw and white (but not with the low-grade centrifugals), and had found them to give satisfaction. Mr. S. C. SMITH added that in beet factory practice he had found that what little wear of the screens was caused, it was more than compensated by the speed gained, while the men could be kept at the machines more readily. Mr. R. J. RICHMOND remarked that he had experienced some little trouble with the ploughs damaging the screen. He had noticed that the plough would not enter sticky sugar. A recently protected improvement takes the shape of another scraper at the heel of the plough to start hard sugar. Mr. G. F. RENTON, Jr., said that he had employed the Gibson apparatus on 40 in. machines for commercial and No. 2 sugars, and observed that the larger the grain the easier it is to discharge the sugar. He added that in his experience these dischargers shorten the life of the screens considerably. Commenting upon these replies, Mr. LOUGHER remarked that the patent lock screen (made by the American Tool and Machine Co.) has helped to diminish the screen damage; but that to make the discharger more generally successful the use of a much heavier screen than at present obtains is necessary to resist the thrust in cutting down a sugar dried more than a certain extent of what is considered to constitute a good discharging condition.

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[1] *I.S.J.*, 1919, 133 and 175.

Question 3.—(a) Do you cool or dry your sugar, and if so, how? (b) What is your opinion regarding the effect of this practice upon the weighing of the sugar in the bags, and its keeping qualities?

Mr. J. W. DONALD said that the cooling and drying of sugars (as by passing them through a Hersey dryer without steam) have a pronounced influence in preventing the caking of the product during storage, though these operations have no influence on either the weight of sugar in the bags or its keeping qualities in the warehouse. Mr. J. P. FOSTER's opinion was the same. On the other hand, J. E. BIELA said that he firmly believed that if the sugar were cooled before bagging the difference of weights at factory and refinery would be partially eliminated. Mr. G. F. RENTON, Jr., also believed that cooling would render weighing more reliable. Mr. LOUGHER commented that in all instances in which cooling had been practised the result was advantageous, since caking was prevented. Further, the keeping quality of the sugar would be improved if the factor of safety is near its limit, owing to the diminution of the water content between centrifuging and bagging by the drying.

Question 4.—Which is the best way to weigh sugar, and what is your opinion of automatic scales?

Mr. G. F. RENTON, Jr., considered that the most accurate procedure is to weigh each bag on a platform scale. Automatic scales are satisfactory and fairly accurate, and have the advantage of speed over the platform type of apparatus; but he had not yet found the system by which sugar can be weighed both accurately and speedily. R. C. PITCAIRN said that at Wailuku the sugar is fed from a feed box to a Richardson automatic machine and then to a Howe scale, which latter is daily checked against a Fairbanks scale with standard weights. Mr. LOUGHER, summarizing, remarked that for consistent weighing with an automatic scale the sugar must be very dry and free, and that where these machines are in operation it is customary to check-weigh with a platform scale. It would therefore appear that the automatic scale is not reliable in dealing with a sticky sugar without considerable attention.

Question 5.—How many lbs. of sugar do you pack in a bag, and to what extent does the use of the 130 lb. compared with the 125 lb. bag lessen the cost of containers?

Replies indicated that 125 lbs. to the bag is the amount most generally packed. One factory reported the practice of putting 130 lb. in the bag, finding the saving in cost to be $5500 for 32,000 tons of sugar. In order to reduce the breakage, the logical thing to do would be to purchase burlap of a size that would permit a slight increase in the width of the package instead of adding to its length. The greater the length, the greater the tendency towards breakage.

Question 6.—What methods do you follow for facilitating the "drying" of low grade sugars? What modifications in boiling and crystallizing are of influence?

Mr. H. S. **Walker** replied that to facilitate the "drying" of low grades massecuite, he diluted with water in the crystallizers. He considered that modifications of the method of boiling, such as graining on high purity liquors, cutting, etc., seem to have very little influence so long as fine grain is prevented. Previous to drying, the low grades are kept in the crystallizers for as long as possible, that is 9 to 15 days, depending upon the rate of grinding and the purity of the juice. He uses U-crystallizers, of 700 cub. ft. Water-jacketed apparatus afford better control and allow quicker cooling, but for a given amount of money he preferred buying twice as many of the open type. He considered that the yield of sugar from a massecuite depends almost entirely upon the amount of water left in it. If a massecuite yielding final molasses of 97° Brix could be handled, there would be no trouble in keeping the gravity purities down to 30° He is planning next year to return to the method of adding hot waste molasses in the centrifugals by running it in from a circulating pipe system just after a machine is started. This method appears to have advantages over other ways of heating or diluting massecuite, in that the warmed molasses remains a shorter time in contact with the sugar crystals than if the addition were made elsewhere.

Mr. S. C. **Smith** said that during the past season, about 24 hours before emptying the crystallizers, he diluted the massecuite with about 100 cub. ft. diluted molasses at 38° Bé. at 130-140° F. (54-60° C.), that is, about 10 per cent., and the purity of the molasses was the lowest obtainable, namely, 32-35°. Some of this diluted waste molasses was also introduced into the centrifugal with the massecuite. In his opinion, the main results are obtained in the pan, for if the massecuite has not been so treated as to have the right purity, Brix, and temperature, and also the right grain, its defects cannot be corrected elsewhere. It is fundamental to have the purity and the Brix of the No. 1 molasses at the closest possible point, and to attain this with the minimum of boiling back, in order to eliminate an excessive content of gums. At Puunene the limits of purity of the massecuite are 50-56°, giving a waste molasses of 30-36°, and a sugar above 70° apparent purity. Low grades should be boiled rather hot as slowly as possible to give a hard grain. They should be cut as many times as the nature of the grain will allow, being dropped between 98-99° Brix at as low a temperature as possible. He keeps the low-grade massecuite in the crystallizers 7 to 10 days before drying, and uses 12 jacketed apparatus and 18 single-shell, 9 ft. diam. and 20 ft. long, having 1200 cub. ft. capacity. Mr. **Lougher** added that separating molasses from sugar in high density boilings is a problem for much thought and experiment. The application of hot molasses, water and steam now used as thinning media, has yet to be modified, so that the time of drying is diminished, and no material increase in the purity of the final molasses results.

An effort is being made in the United States to induce the Government to permit the wider use of saccharin, and the matter was recently brought before the Senate Committee of Agriculture. Replying to the plea of the President of the Monsanto Chemical Works, of St. Louis, that a certain amount of the coal tar derivative be allowed to replace sugar for the sweetening of "soft drinks," Dr. **Carl Alsberg**, Head of the Bureau of Chemistry, Department of Agriculture, said in the course of his statement: "In my judgment to permit the unrestricted use of saccharin would be contrary to public interest. It is deleterious to public health, and it will debase the food supply of the country as a whole. The best evidence of that statement is the fact that it will actually reduce the *per capita* consumption of sugar."

Loss of Sugar occurring between Cutting and Milling.[1]

By E. T. WESTLEY.

It has always been known that a certain amount of sugar is lost during the time elapsing between cutting and milling. Previous to carrying out the tests here described, the writer thought that after two or three days the cane did not lose any appreciable amount. He now has a different idea on the subject.

In Hawaii this matter has never been given much attention, probably because the field and the mill are entirely different departments, one knowing very little of what the other is doing. The field men are interested in getting the cane to the mill as easily and cheaply as they can, while the mill men assume the product reaches them as quickly as possible after it is cut.

It would appear that too little attention has been paid to this loss. The field men have concentrated upon larger crops, and the mill men upon larger extractions; but it is bad business to devote much time and money to the growth of cane, and in a few days lose a good part of the sugar present in it.

Thirty sticks of uniform Yellow Caledonia were divided into ten samples, which were subsequently ground on successive days, the weight of each lot being also taken from day to day. The figures are shown in the table reproduced herewith.

AGE OF CANE AFTER CUTTING, DAYS.	WEIGHT OF THE CANE, LBS.	WEIGHT LOST, PER CENT.	ANALYSIS OF THE JUICE.				SUGAR PER 100 OF CANE.	SUGAR LOST, PER CENT.
			Brix.	Polarization.	Purity.	Quality ratio.		
—	17½	—	21·7	18·78	86·54	7·11	14·065	—
1	17	—	21·8	20·07	92·06	6·44	15·527	—
2	16¾	1·38	22 30	19·75	88·56	6·68	14·763	5·57
3	16½	4·76	22·00	18·05	82·05	7·59	12·548	19·19
4	16¼	6·15	22·60	18·19	80·49	7·61	12·332	20·58
5	16½	4·48	25·50	17·06	75·82	8·40	11·371	26·77
6	16¼	4·00	22·70	16·02	70·57	9·36	10·256	33·95
7	16	6·15	22·70	16·44	72·42	8·97	10·463	32·61
8	15¾	10·29	23·30	17·50	75·06	8·24	10·887	29·88
9	15½	11·43	23·10	17·42	75·41	8·25	10·736	30·86

Other tests were carried out with D.1135, Lahaina, and H.109. In the case of Lahaina and H.109, for example, the increase in the tons of cane required to manufacture a ton of sugar after two, four, and six days was: 0·07, 0·11; 1·37, 0·43; and 3·48, 0·80 per cent. respectively for the two varieties. By combining the weight losses and the decline in quality, the loss of available sugar was calculated to be after two, four, and six days for the same two kinds of cane: 5·7, 2·8; 24·7, 12·2; and 41·4, 18·0 per cent. respectively.

These losses are really less than might actually obtain, as the same formula for expressing the quality ratio was used for fresh and old cane alike. It is obvious that the fibre per cent. would increase as the cane dried up; while if the actual polarization per cent. had been determined in all cases, still higher losses would have been indicated. Moreover, not only is there a loss of sugar, but also a deterioration of the quality of the juice, making milling and boiling more difficult.

It might appear from the figures given that Lahaina deteriorates faster than H.109; while other figures appear to demonstrate that Y.C. preserves best of all four tested. The writer is inclined, however, to believe that it is not the difference in the variety so much as the stage of ripeness and climatic conditions prevailing at the time the cane is cut.

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[1] Summary of a Paper presented to the Seventeenth Annual Meeting of the Hawaiian Chemists' Association.

Although all the cane on a plantation cannot be brought to the mill within 24 or even 48 hours after it is cut, the percentage of cane that is 36 hours old can be considerably reduced. The Hawaiian Experiment Station claims that the crop of the territory could be increased by 30,000 tons of sugar if the cane were ground one day earlier after cutting than at present. In the writer's opinion this estimate is a very conservative one.

Electricity in the Sugar Mill.[1]

By E. P. GIBSON

A number of papers have been presented before the Association on the subject of electricity in the sugar industry, and it has been agreed that the electrification of certain auxiliaries, such as pumps, crystallizers, conveyors, mixers, compressors, etc., is advisable. Many mills have installed such equipment or are contemplating doing so. We are not yet ready, however, to apply electric drive to the rolls, though some of the mills in Cuba have done so with satisfactory results.

In all mill practice there should be standardization as far as possible. Applying this to our electrical installations, we find that it has its advantages.

Alternating current, of course, should be standard. Alternating-current motors are more rugged in construction, require less attention, and are better suited for mill work than the direct-current motors. The initial cost per H.P. is less for both motor and wiring as compared with direct current. The time is not far off when all plantations on each island will be inter-connected by transmission systems, and this would only be possible through the use of alternating current. It was only a few years ago that the various power companies on the mainland depended on their own power to supply their needs. We now find large districts so tied together that any company within the district can be fed from one of its neighbours, thus assuring continual service to its customers. When all the mills adopt electrification, such connecting lines would, at times prove advantageous.

Three-phase, sixty cycles should be the next standard. Three-phase is now a national standard; and sixty cycles gives a good combination of speeds for the motors.

The question of motor voltage is a matter of opinion, and there are two possibilities, namely, 220 and 440. The writer prefers 440 as a standard. The cost of wiring materials per horse-power is almost half that of 220 volts; the motors above 25 H.P. cost less; and personal danger and fire hazard are no greater with 440 than 220. A man will take risks handling 220 volts, and the conditions may be right for a fatality, but more precautions are taken with 440, and thus accidents are few. This brings the power standard to 3-phase, 440 volts, 60 cycles. The lighting should be 110 volts.

Of the two systems of installing wiring, namely, knob and tube, and conduit, the former is found in most mills in Hawaii, and consists of wires run exposed on porcelain insulators. The latter is a little more expensive to instal, but is by far the better method. Wiring work should conform in every detail to the electrical code of the National Board of Fire Underwriters.

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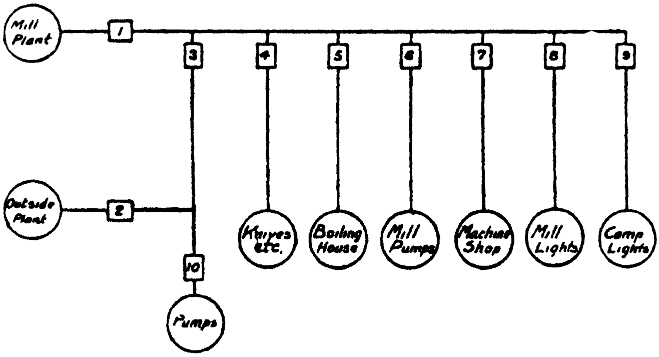
[1] A Paper (here abridged) presented to the 17th Annual Meeting of the Hawaiian Chemists' Association.

Electricity in the Sugar Mill.

In laying out the wiring in a mill, provision should be made for at least six separate circuits from the switchboard in the mill. Each of these circuits should extend to a main distributing cabinet, and from these cabinets separate lines should be carried to the individual motors. At the switchboard, each circuit should be protected by an oil switch that would trip automatically when the circuit is overloaded. An ammeter should be provided on each circuit, showing the current taken by that circuit. In the distributing cabinet a separate fused switch should be installed on each line to the motor to allow breaking of the motor circuit, and the fuses will protect the main feeder should an excess load come on the individual motor line. Each motor should then be protected by a relay tripped switch. Motors developing 7½ H.P. and above of the squirrel cage type are furnished complete with this device; and when below this size, and when of the wound rotor type, they can be provided with a relay-operated automatic oil switch. The above mentioned relay is a magnet coil so wound that when the current taken by the motor rises above a certain predetermined value, the magnet plunger operates a trip and throws the switch to the off position. It also has the feature of time element, which allows for momentary overloads without operating the trip. An ordinary fuse blows the moment the current exceeds its rating, then comes the cost of fuse replacements. The relay, after tripping, drops back into position and the motor is ready to start as soon as the cause of the overload has been removed.



The six circuits should be divided in the mill as follows: (1) Mill circuit, controlling shredder motor, knife motors, unloader motors, raw juice pumps, bagasse conveyors, car haul; (2) Boiling-house, controlling centrifugal motors, evaporator pump, juice pumps, conveyors, crystallizers, mixing tanks, washing machines; (3) Pumps, controlling condenser pumps, water supply; (4) Shop equipment, controlling blacksmith shop, carpenter shop, machine shop, ice plant; (5) Lights controlling all mill lights; and (6) Outgoing lines, controlling all power to outside pumps, camps, rock crusher, etc., and to return-power coming from outside source into the mill.

It is essential that the proper metering equipment be installed in order that each division of the plantation shall share its correct part of the manufacturing costs and line losses. In the sketch is shown the most advisable method of metering. A watt-hour meter records, on its dials, the total kilowatt-hours consumed. The mechanism is nothing more than a motor so designed that one revolution represents a certain amount of power passed through. This motion is transmitted through a train of gears and the kilowatt-hours are read directly on the meter (see sketch). There should be a watt-hour meter at No. 1 giving the total output of the mill generators, another meter or meters at No. 2 giving the output of all outside sources of power. The sum of these two will then give the total power generated. Meter No. 3 is used to determine the power sent into the mill from outside sources, and vice versa. Meters, 4, 5, 6, 7, 8, 9 and 10 give the total power consumed in the various departments. The sum of readings 1 and 2 will be greater than 4, 5, 6, 7, 8, 9, and 10 by the amount equal to the line and transformer losses. These losses should be charged *pro rata* to the various departments. They will in some cases be as much as 15½ per cent. of the generated power, especially where there is a large outside distribution system. The various departments within the mill should only share their proportion of the loss on the power delivered to it from the outside, for if the mill depended on its own generator, meter No. 1 should equal the sum of the readings of 3, 4, 5, 6, 7, 8 and 9. The outside departments would then be charged as per reading on meter No. 3, and their losses would be the difference between 3 and 10.

Each mill should be provided with proper portable testing equipment, including one polyphase indicating wattmeter, 5-10 amp., 150-300 volt scale; two portable current transformers capable of handling 1000 amps., and adjustable to several ratios; two portable potential transformers or multipliers[1]; one 5-ampere ammeter and one 150-600 volt voltmeter.

Trade Notices.

The Harvey Engineering Company, Ltd., Scotland Street Engine Works, Glasgow, have just issued a booklet of views of their works and manufactures, under the title of "Peace Reorganization." In keeping with most other British manufacturers of sugar machinery, they were engaged during the war almost exclusively on the manufacture of guns and ammunition for the British Government, but since the Armistice they have been busily reorganizing their works for the manufacture of sugar machinery once more, and are now completely equipped for producing this class of machinery by the most up-to-date methods; they are moreover now in a good position to undertake orders for every class of sugar machinery, and to give quick delivery. The illustrations to this booklet include typical views of the firm's engineering shops, and show some of the most notable of their war-time productions, including Hotchkiss quick-firing guns, 4·5 in. field howitzers, 18-pounder field guns, 15 in. naval proof shot, and armoured motor cars on Rolls-Royce chassis. The firm's well known designs of sugar machinery also figure among the illustrations.

Under the title of "Hilger Instruments in Industry," Messrs. Adam Hilger Ltd., 75a Camden Road, London N.W. 1., have published an 8-page pamphlet which summarizes some of the many purposes to which instruments constructed by this firm are put. Polarimeters, it is pointed out, are applied to the control of various industries other than those of sugar and starch manufacture or of brewing, being in the service of manufacturers of tartaric acid, alkaloids, vegetable and essential oils, etc. Optically-inactive chemical products, as acetone and boric acid, can be estimated with the aid of this instrument by observing their effect upon an optically-active subtance. Refractometers find use in factories engaged in the production or utilization of essential oils, mineral oils, vegetable oils and waxes, rubber, alcohol, leather, etc., etc. Messrs. Hilger, Ltd., make several other instruments of diverse application. Their wave-length spectrometer is of value in many directions, *inter alia*, for the quantitative control of dyeing tests, for the absorption of coloured glasses, and for the general study of illuminating sources. Their spectrographs are of considerable value in the examination of metals and ores; and by means of type C, for example, it is possible to obtain a permanent record of the metallic constituents of a metal. Twyman's apparatus for determining the annealing temperature of glass is of great importance in the manufacture of all kinds of glassware, including optical glass; while this inventor has also devised a "viewer" for the rapid examination of strain in glass.

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[1] If the motors are 440 volts a 4:1 ratio is necessary; if 220, these transformers are not needed.

Publications Received.

Handbook of Colloid Chemistry. By Dr. Wolfgang Ostwald. Second English Edition, translated by Dr. Martin H. Fischer, with Notes by Emil Hatschek. (J. & A. Churchill, London). 1919. Price: 15s. net.

There are several textbooks forming an excellent introduction to the important subject of colloid chemistry (certain of which have recently been introduced to the notice of our readers[1]); and OSTWALD's well-known handbook may be recommended to those desiring to pursue their studies further. A first English edition was published in 1915, being a translation of the third German impression, but it was quickly exhausted. Yielding to pressure from the publishers, Dr. FISCHER in America, and Mr. HATSCHEK in this country, co-operated in undertaking the preparation of this second English edition, though recognising that to make such a revision while the author was "alive in another country" (as the preface states) was a delicate as well as a difficult task. This situation, it was thought, could best be met by leaving entirely untouched those large portions of the text containing the author's individual views, while adding "numerous paragraphs intended to bring to the reader various important advances in colloid chemistry which have been made in 1912, such as have to do with the mechanical properties of colloids, more particularly their viscosity." This work has been well carried out, and the result is a volume that cannot fail to be of value to the large number of workers in different branches of science and industry who recognize the importance of the part played by colloid substances in a variety of phenomena.

Definitions and Standards for Food Products (including Sugars, Syrups, and Starch Glucose.) *U.S. Department of Agriculture, Circular 136.* (Office of the Secretary, Washington, D.C., U.S.A.) 1919.

Definitions and standards for food products are stated in this Circular as a guide for the official of the Department of Agriculture in enforcing the Food and Drugs Act. Granulated, loaf, cut, milled and powdered sugars are defined as different forms of sugar, containing at least 99·5 per cent. of sucrose. Molasses is given as the product obtained after separating sugar from massecuite, containing not more than 25 per cent. of water, and not more than 5 per cent. of ash.[2] Refiners' syrup or treacle also should not have more than 25 per cent. of water, but in this case the ash limit is 8 per cent. Sugar cane syrup made by the evaporation of cane juice, or by the solution of cane juice concrete, contains not more than 30 per cent. of water, and not more than 2·5 per cent of ash. Starch glucose, so called anhydrous, contains not less than 95 per cent, of dextrose, and not more than 0·8 per cent. of ash. The "hydrous" form may be of two grades, the first known as "70 sugar" or brewers' sugar, containing 70 per cent. of dextrose and 0·8 per cent. of ash; and the second, called "80 sugar" "Climax" or "Acme" sugar, containing 80 per cent. of dextrose and not more than 1·5 per cent. of ash. Other products described include meats, milk products, grains, fruits and vegetables, edible oils and fats, tea, coffee and cocoa products, beverages, and baking powders.

Saving Steam in Industrial Heating Systems. Technical Paper 221; Department of the Interior, Bureau of Mines, Washington, D. C, U.S.A. 1919. (Government Printing Office, Washington, D. C., U.S.A.) Price: 5 cents.

Large economies are frequently possible in heating an industrial factory, and a source of easily preventable loss often incurred is that of the use of live steam for purposes for which exhaust steam would be at least as satisfactory. This bulletin calls attention to some faults of design and operation leading to such an uneconomical use of live steam, and describes means for correcting them.

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Carbon Black: A Bibliography. E. H. McClelland. (Carnegie Library of Pittsburgh, U.S.A.) 1920.

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[1] *I. S. J.*, 1916, 39; 1919, 189, 463.

[2] See also *I.S.J.*, 1919, 622.

Nature of Enzyme Action W. M. Bayliss, M.A., D.Sc., F.R.S. Fourth Edition. (Longmans, Green & Co., London and New York). 1919. Price: 7s. 6d. net.

BAYLISS' monograph summarizes in a very complete and lucid manner our present knowledge of an important branch of biochemistry, and in this latest edition the text, and also the valuable bibliography, is brought up-to-date. Enzymes are defined as colloidal catalysts. By their use the living organism is enabled to bring about under ordinary conditions of temperature many chemical reactions which in the laboratory would require considerable heat and the use of powerful reagents. Their destruction by heat is in all probability due to their colloidal nature. It is believed that reactions catalysed by enzymes are reversible in nature, and many cases of synthetic processes occuring under the influence of enzymes have been brought forward, leading to the impression that it is merely a question of obtaining the right conditions in order to obtain synthesis from all enzymes. Regarding the synthesis of sucrose by enzymes, ROBERTSON, IRVINE, and DOBSON[1] found that preparations of the enzymes in the leaf and stem of the beet caused the production of sucrose to the extent of 6 per cent. when allowed to act upon a concentrated solution of invert sugar; while VISSER[2] claimed to have observed a similar effect when invertase was allowed to remain in contact with a solution containing dextrose and levulose for some time. Several other aspects of this very interesting subject are dealt with by DR. BAYLISS, such as the mode of action of enzymes, co-enzymes and anti-enzymes, in which fields important new discoveries have recently been made. A perusal of this volume is strongly recommended to all those interested in the study of biochemistry.

At Manchester University it is proposed to establish a chair of colloidal chemistry, and £11,000 of the £25,000 required for this purpose has been subscribed.

It is reported that distillers in Scotland have made a definite move to produce power alcohol. They are considering a scheme for building new distilleries, in order to raise the quantity of alcohol from home production to 30 million gallons.

In a paper read before the Cleveland Institution of Engineers, Middlesbrough, Mr. E. BURY, of the Skinningrove Iron and Steel Works, stated that a large-scale process has been worked out for the production of alcohol from ethylene, recovered from coke-oven gas. The yield is stated to be 1·6 galls. of alcohol per ton of coal carbonized.

The Cantley beet sugar factory is to be opened this year providing the East Anglian farmers are willing to place a sufficient acreage under beets. A minimum of 3000 acres is required and the English Sugar Beet Corporation, the owners of the factory, are prepared to pay 70s. per ton for the roots It has been stated in the House of Commons that the Government were not disposed to purchase Cantley, as its design and situation were in their opinion unsuitable for their purpose.

We regret to learn of the death on January 19th of Mr. A. HUGH BRYAN, the well-known sugar chemist, formerly chief of the U.S Bureau of Chemistry under Dr. H. W. WILEY. Mr. BRYAN contributed largely to the literature of the cane, beet, and sorghum industries. He was a referee for the Association of Official Agricultural Chemists, and his various reports upon methods of sugar analysis to this body constitute an important part of its published proceedings.

Our contemporary, the *Chemical Trade Journal*,[3] is also publishing extracts from past issues, in order to contrast the conditions in different industries with the present-day state of development. Under the heading of "Thirty Years Ago," it recalls the work done at the Magnolia Plantation, Louisiana, on the application of the diffusion process to the extraction of juice from cane. "The practical result is that while previously the average yield of sugar per ton of cane was scarcely 145 lbs , it is now over 200 lbs. Moreover, there is already growing up a more scientific agriculture, a better knowledge of the problems of sugar manufacture, a more scientific method in the sugar-house, and the introduction of improved machinery "

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[1] *Biochem. Jl.*, **4**, 258. [2] *Zeitsch. f. physik. Chem.*, **52**, 257. [3] 1919, **65**, No. 1698, 650.

Review of Current Technical Literature.[1]

DETERIORATION OF BAGASSE ON KEEPING. (1) *G. Loos and A. Schweizer. Archief voor de Suikerindustrie in Nederlandsch-Indië, 1919, 27, No. 37, 1772–1775.* (2) *C. Janssen. Ibid., 1919, 37, No. 42, 1974–1975.*

(1) It is to be expected that bagasse should diminish in sucrose content on keeping; but the authors claim to have observed such a rapid deterioration (even in the presence of antiseptic reagents) as to lead them to conclude that the sucrose content as generally determined may be far from correct. At one of the factories under their control, the bagasse from the last mill was sampled during five minutes, mixed, passed through a chopping machine and through a sieve with 4 mm. (⅛ in.) holes, again mixed and lastly placed in a well stoppered bottle. Determinations of the polarization of the contents of the bottle were made at intervals, and it was found that after three hours the sugar content had fallen from 3·15 to 1·77, and after about six hours it had become 0. Neither chloroform nor formaldehyde entirely prevented this deterioration, though both were found to inhibit it in some degree. It therefore seems impossible to avoid the conclusion that the polarization of the bagasse is generally reported too low. Deterioration must have been going on since sampling, and indeed to some extent during the operation of milling. Its rate would depend upon the fineness of the bagasse, and it is remarked it would be interesting to ascertain how fine bagasse coming from a shredder behaves in this respect.

(2) However, the observation made by Messrs. Loos and SCHWEIZER is not confirmed, by Mr. JANSSEN. A sample was taken from the third mill, chopped and sieved, and placed in a stoppered bottle without any disinfectant. Analyses of the contents were made at frequent intervals, but no deterioration could be noticed before eight hours. It is therefore concluded from this result that during the time necessary for sampling, chopping, sieving, etc , no appreciable diminution in polarization takes place.

PROPAGATION OF CANE SEEDLINGS IN BARBADOS. *C. A. Browne. La. Planter, 1919, 1919, 63, No. 11, 170–174; 63, No. 24, 308-381.*

During his recent visit to the British West Indies, Dr. BROWNE had the opportunity of seeing something of the work which has been carried out by Mr. JOHN R. BOVELL, Director of Agriculture, Barbados, and he gives a brief account of some of the seedling experiments which have been carried out there. Cane seedlings were first discovered in Barbados in May, 1858, by Mr. J. W. PARRIS, the proprietor of Highland Plantation, though the possibility was denied at the time. Mr. BOVELL, however, was influenced by PARRIS' work, and in 1888 he noticed among certain grasses and weeds a number of grass-like plantlets which later developed into sugar-canes. In this same year he sowed several boxes of cane arrow spikelets, a number of which were found to germinate, and from that time to the present Mr. BOVELL has continued each year to grow a large number of seedlings. This is done by sowing seed from parent canes (selected for their yield, vigour, etc.,) in boxes about the end of November or the beginning of December in each year. When the young plants come up they are set out in pots, and, after attaining a height of eight to ten inches, are transplanted (usually in April) to a field provided with gutters for irrigation. In May of the following year the canes are examined, and those new varieties which from various characteristics (size, yield, etc.,) appear promising, are cut, weighed, and milled, the resulting juice being analysed. The stools of those canes which show a good weight and sucrose content are taken up, halved, and re-planted in a field that can be irrigated, while in the following December the canes are made into cuttings and planted. Varieties thus propagated and multiplied are grown each year in competition with the White Transparent and B.6450, the two standard canes for comparison. Those new varieties appearing favourable are cultivated on experimental plots in both red and black soil in different parts of the island, until subsequent tests lead to their rejection or adoption for further trial by planters on a small estate scale. As an example of the elimination following from this procedure, it may be mentioned that Mr. BOVELL in 1916 germinated 15,000 plantlets from cane seed; he potted 6,563 of these, and later transplanted 2,957 of the more vigorous; only 375 of the seedlings thus grown were considered worth cutting, and of these 121 were regarded from their weight and sucrose content to be worthy of further experimentation. Inasmuch as seedlings often give returns at first which are not maintained later, the number of really promising canes after the five years' comparison considered necessary is reduced to a very small number. This method for natural seedlings is also employed in the experiments with hybrid and self-fertilized seedlings. In the valuation of seedlings, chief stress is laid upon the following field and factory characteristics : Germinating power ; behaviour under extremes of dryness and moisture ; habit, as uprightness or recumbent ; resistance towards insects and fungi ; period of growth ; productive power in tons of cane per acre ; tonnage of tops ; milling quality, whether rough or brittle ; fuel producing quality, depending upon the percentage of fibre ; amount of expressible juice ; sucrose content of the juice ; and lastly, the purity of the juice. During the experiments carried out in the period 1914-18, results have been obtained from a hybrid seedling, B.H. 10 (12), which are vastly superior to those of any other. It yields over 40 tons of cane and 4·68 tons of sucrose per acre, and a normal juice of 22° Brix, 20° polarization, and 90·9 purity. Its fibre content is more than sufficient to heat the boilers and the excess of bagasse had to be stored. Other seedlings, as Ba. 6032, W. No. 2, B.12,619, and Ba. 8069, have given good results, considerably better than those obtained with the White Transparent.

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[1] This Review is copyright, and no part of it may be reproduced without permission.—(Editor, *I.S.J.*)

EFFECT OF THE OIL CONTENT OF EXHAUST STEAM UPON THE EFFICIENCY OF THE HEATING SURFACE. *H. Claassen. Zeitsch. ver. deut. Zuckerind. 1919, 128-155.*

In a certain factory in Germany the exhaust steam used for the evaporators was found to deposit oil on the tubes, although after leaving the engines it had been passed through a separator to eliminate most of this impurity. An examination of the multiple effect at the end of the season showed, however, that it was only those tubes opposite and close to the steam inlet that had become coated with the oil, and that in any case the film did not exceed 0·005 mm. in thickness. A layer of oil, as is known, exerts a marked influence on the transmission of heat through a tube ; but under the conditions obtaining in practice, since the number of tubes which can become covered in this way are not great, the diminution of the efficiency of the total heating surface of the evaporator is quite inconsiderable.

INFLUENCE ON THE DURATION OF CONTACT OF THE SCUMS WITH THE FIRST SATURATED JUICE IN THE BEET FACTORY. *Vl. Stanek. Zeitschrift fur Zuckerindustrie in Bohmen, 1918, 42, No. 6, 417-423.*

Many technologists consider that the sooner the scums are filtered from the first saturated juice in beet sugar manufacture the better, it being suspected that long contact results in the re-solution of some of the impurities. Laboratory and factory experiments made by the author disprove this, it being found that unfiltered first saturated juice increased in purity (from 93·3 to 94·1°) by being stirred at 85° C. for an hour, while the lime, ash, alkalinity, and the colour generally remained practically unchanged. Most noticeable also was the improved ease of filtration. It is suggested that the increase in the purity might be explained either by the decomposition of the tricalcium saccharate or the "sucro-carbonate," sugar passing into solution, or else by the liberation of sugar adsorbed by the collodial amorphous calcium carbonate, which during the stirring had become crystalline. It would seem that the latter cause was the more likely one, since the alkalinity had not increased, though the possibility is not excluded that an increase of alkalinity caused by the decomposition of the trisaccharate had been masked by a decrease in the same factor by the decomposition of amides with volatilization of ammonia. Anyway, it is considered that stirring the first saturated juice for 30 minutes provides an easier means of obtaining scums that filter rapidly and "sweeten off" readily, than the usual practice of separating with as little delay as possible.

Review of Current Technical Literature.

PREPARATION OF GLUCONIC ACID FROM STARCH GLUCOSE OR INVERT SUGAR. *A. Herzfeld and G. Lenart. Zeitschrift des Vereins der deutschen Zuckerindustrie, 1919, No. 758, 122–128.*

In 1915 there was still a sufficiency of sugar in Germany, but a scarcity of acids as citric and tartaric. Experiments were therefore conducted by the authors with the object of endeavouring to simplify the preparation of gluconic acid, which (it was thought) might serve as a substitute for vegetable acids for use in certain foods and drinks; and the following method[1] was elaborated: One part by weight of glucose (prepared from starch by hydrolysis), dissolved in 5 parts of water, is shaken with 1 part of bromine in a closed vessel for about two hours until the reagent has dissolved, after which the oxidation is completed by allowing the mixture to stand in a warm place for 24 hours. At the end of this time, the unchanged bromine is distilled off *in vacuo*, heating being continued until the liquid commences to develop colour. When this occurs, the residue is diluted with water to about 350 times its volume, and the hydrobromic acid present exactly neutralized with sodium carbonate[2]; then a slight excess of calcium carbonate is gradually added at a temperature of 90° C., the lactone formed during the distillation being broken up at the same time. After standing for two or three days at as low a temperature as possible, a crop of crystals of the calcium salt forms, and these are re-crystallized. It is stated that by working up the mother-liquors an almost quantitative yield is obtainable. Instead of starch glucose, invert sugar may be used, in which case only the dextrose is oxidized, so that the levulose can be separated by precipitation with lime, or can be converted to levulinic acid by boiling with dilute hydrochloric acid. Experiments on the use of chlorine instead of bromine for oxidation have also been made, and the result of these will be reported shortly.

DETERMINATION OF THE CALCIUM OXIDE OF MILK-OF-LIME. *G. Lenart. Zeitschrift des Vereins der deutschen Zuckerindustrie, 1919, Nos. 756 and 764, 1–15* and *360–361.*

Mategček's table[3] correlating the sp. gr. and CaO content of milk-of-lime is generally acknowledged to be far from correct; while that of LUNGE and BLATTNER[4] is considered by the author also to be unreliable, because it is based on determinations of the density using the hydrometer, and of the CaO volumetrically, both of which procedures are here shown to be untrustworthy under the conditions followed. Experiments are described showing the difficulty of obtaining reasonably exact results by means of the hydrometer, since the readings are influenced by the length and shape of the spindle, by the weight and width of the column of liquid in the cylinder, and by the degree of movement imparted to the liquid when making the reading. In Lunge's well-known work[5] a method is described in which 25 c.c. of a 10 per cent. solution of the milk are titrated against N/1 HCl, using phenolphthalein as indicator, but if a pipette be used for abstracting the portion for the assay rather considerable deviations will be found on carrying out a number of determinations, due of course to the greater or less amount of insoluble matter settling in the tip of the pipette while adjusting the volume to the mark. The liquid taken should therefore be rapidly abstracted by a wide-mouthed tube, and weighed. For the determination of the density of milk-of-lime, more reliable results are obtained by means of a pycnometer, and a glass or metal cylinder having a content of 500–1000 c.c., and covered, by a glass plate, gives sufficiently exact results. Using this apparatus, the author has constructed a new table showing the sp. gr., the Bé., and the Brix readings, and the corresponding CaO and $Ca(OH)_2$ contents from 1·0085 to 1·2195 (1·5 to 26·2° Bé.) for 20° C., temperature corrections being also stated for 30 and 40° C.

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[1] Previous processes proposed had involved the use of alcohol or the oxides or hydroxides of the heavy metals for the elimination of the hydrobromic acid.

[2] The exact amount necessary being found by titration of an aliquot portion.

[3] *Österr.-Ungar. Zeitsch. Zuckerind.*, 1871, 12, 1718.

[4] *Dingl. Polytech. J.*, 1883, 466.

[5] Lunge-Keane: Vol. I, Pt. 1, 484.

PREPARATION OF CARAMEL FOR COLOURING SUGARS TO CONFORM WITH A CERTAIN DUTCH STANDARD VALUE. ***J. Penning.*** *Sugar News, 1919, 1, No. 3, 18-22.*

Sugar entering the Japanese market is assessed for duty according to the Dutch Colour Standard; and under this system it is often necessary for manufacturers of sugar destined for Japan to add a solution of caramel to the crystals after pouring in the centrifugals. This is done at the present time in Java in the case of sugars of a certain polarization; and for the guidance of those in the Philippines, who may be exporting sugar to Japan, Dr. Geerligs' directions for the preparation of a caramel for this purpose are reproduced, these being as follows: 120 kilos. of sugar, dissolved in 35 litres of water and 35 litres of lime water, are slowly boiled in a copper pan over an open fire, stirring meanwhile, and ladling off the scum from time to time. After about two hours, hot water is added, the fire withdrawn, and the clear liquid resulting from subsiding syphoned off and diluted to 100 litres. The temperature should not be allowed to rise above 100° C. As this method gives a product still containing a considerable amount of unchanged sugar, and having a purity of about 70° C. (not less than that of the molasses adhering to the sugars of olden days), it is considered by the author of this paper preferable "to supply the market with a merchandize exactly identical with the one on the quality of which the Dutch Standard was originated." He therefore advises adding milk-of-lime to molasses in a tank and blowing up with live steam, stirring all the time, "smell and experience being relied upon to tell whether the product is cooked." This should give a liquor having a Brix of 55° to 60°, which is diluted suitably.[1]

ATTITUDE OF THE NEW YORK SUGAR TRADE LABORATORY ON THE U.S. BUREAU OF STANDARDS VALUE FOR THE 100° POINT OF THE SACCHARIMETER. (1) ***C. A. Browne.*** *Facts about Sugar, 1919, 9, No. 24, 470-471.* (2) ***F. J. Bates*** *Ibid., 1919, 9, No. 24, 471.*

(1) Referring to the new value for the standardization of the saccharimeter established by BATES and JACKSON,[2] of the U.S. Bureau of Standards, it is stated that the directors of the New York Sugar Trade Laboratory (representing equally buyers and sellers of raw sugar in America) after careful consideration have voted against its adoption, for the following reasons:—(*a*) That this new value has been criticized by European investigators,[3] and has not been confirmed internationally, so that it would be exceedingly unwise to accept a standard that later might be abandoned. (*b*) Granting that there may be a slight error in the present standard, and granting that the new value of the Bureau may be correct, it is probable that no injustice is being done at present to the sellers of raw sugar, for the reason that the minus error due to the scale graduation is compensated by an equal (or greater) error due to the volume of the lead precipitate in clarification. If an error in the graduation of the scale exists, it should be corrected, and the true value fixed by international agreement. Likewise, the error caused by the volume of the lead precipitate should be eliminated, either by dry lead acetate clarification as proposed by HORNE,[4] or otherwise. This conclusion of the directors of the Sugar Trade Laboratory is in complete agreement with that expressed by DR. PRINSEN GEERLIGS of Holland and other European authorities.

(2) Mr. BATES stated that the only criticism of the work carried out by him and Mr. JACKSON is a comment by HERZFELD "about 150 words in length confined to a short discussion of several minor points involved in the preparation of the sugar used by the Bureau of Standards. DR. HERZFELD merely conveys the idea of a possibility of the existence of a slight error due to these causes, and does not furnish the slightest proof that any error was made. On the contrary, all measurements and all contributory data developed since the determination of the constant by the Bureau have merely served to verify the correctness of the new value."

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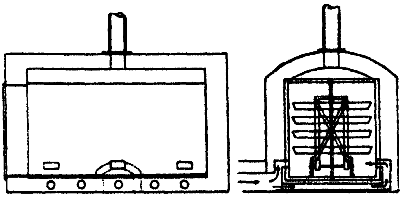
[1] In the commercial manufacture of caramel, a product suitable for spirit colouring is obtained by heating a cane sugar syrup at about 50° Brix with sodium hydroxide, and diluting with water to a specific gravity of about 1360. A beer caramel is generally made from starch glucose, which is melted, treated with solid ammonium carbonate, and heated.—ED. *I.S.J.*

[2] *I.S.J.*, 1917, 380. [3] *I.S.J.*, 1919, 520. [4] *I.S.J.*, 1919, 406.

Molasses Utilization, as Fuel, for the Recovery of Potash, for the Manufacture of Motor Spirit ("Natalite"), and for the Production of a Camp Fuel. *S. S. Peck. Paper presented to the 17th Annual Meeting of the Hawaiian Chemists' Association.*

In 1918 about 150,000 tons of waste molasses were produced in Hawaii, and of this 60 per cent. was shipped to the mainland, 10 per cent. used for the recovery of potash, 7 per cent. fed to stock, 15 per cent. burned for fuel, and 8 per cent. was thrown away. At the Hawaiian Sugar Co.'s factory, the by-product is burned for the recovery of potash in an apparatus designed by Haldén, the furnace being 3 ft. wide, 5 ft. long, and 5 ft deep. The molasses is preliminarily heated in iron pans placed above the fires and over the flue, being fed from time to time into the furnaces, where it burns readily with the production of great heat. At present the plant burns seven to eight tons of molasses per day, producing about 1500 lbs. of ashes, or about 450 lbs. of potash; and at the Territorial Fair held in Honolulu this model was shown in operation, being awarded a first prize and a special award by the Commissioners. Connected with the molasses burner is an oven (shown in the sketch) for baking a mixture of three parts of molasses and one of bagasse (the latter being partly dried), an excellent fuel being obtained, which is preferred by the labourers to coal or wood. The oven is of brick, 6 ft. × 12 ft. × 6 ft. high, so arranged with double walls and openings for circulation that the heat from the burner completely fills this chamber before going out to the stack. Its pans, 5 ft. square and 6 in. high, are placed on trays mounted on rails, so that they can be rolled into the oven through a large iron door. After 24 hours the contents of the pans (which are subjected to a heat of about 450° F. (222° C.) is completely charred, and can be removed in a solid block. At the Maui Agricultural Co.'s plantation, a gasoline substitute, consisting of alcohol and ether ("Natalite") is being turned out at the rate of 350 gallons per day. A force of three men is employed, and the cost per gallon exclusive of the value of the molasses amounts to 7·87 cents. A ton of the molasses produces about 60 gallons of the motor fuel, and the value of the fertilizing elements remaining in the fermented wash is about $8·00. Attention is directed to the possibilities of using molasses for the production of glycerin and acetone, details of which have already been published.[1] It is of some interest to give the values of the different products that may be produced from a ton of molasses under present conditions in Hawaii, without attempting to arrive at the actual profit that may possibly be derived from such methods of utilization, these being given as follows :



		$.
1.	Sale to mainland, at $4·00,	4·00
2.	Production of potash, 4 per cent. at 10 cents. per lb.,	8·00
3.	Substitute for fuel oil	2·00
4.	Stock feed,	40·00
5.	Motor spirit, at 25 cents per gallon,	15·00
6.	Motor spirit, including potash recovery	23·00
7.	Camp fuel, coal being $24·00 per ton,	14·00
8.	Glycerin and alcohol at 18 and 35 cents. per lb. respectively	53·50
9.	Acetone and alcohol, former at 13 cents. per lb.	22·60

Centrifugal Separators. *E. A. Alliott. The Chemical Age, 1919, 1, No. 27, 717-718.*

A resumé is given of a lecture delivered at the Manchester College of Technology dealing with the following points *inter alia* :—Principle of the machine ; baskets ; power and speeds ; swinging spindle centrifugals ; continuous centrifugals ; and other types of machines, as the Schaefer, Ter Meer, Elmore, Gee, and Sharples.

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[1] *I. S. J.*, 1919, 243, 340, 412.

DETERMINATION OF SUCROSE IN CANE MOLASSES BY WALKER'S DOUBLE POLARIZATION METHOD, USING DRY BASIC LEAD ACETATE CLARIFICATION. *Alex Brodie.*

Paper presented to the 17th Annual Meeting of the Hawaiian Chemists' Association.

It will be remembered that in a method proposed a little time ago by H. S. WALKER[1] certain modifications were introduced, the advantages of which were claimed to be greater accuracy and greater convenience in operation. Clarification was effected by means of *dry* basic lead acetate (Horne's process[2]), and the direct reading was made with a solution rendered acid by the addition of phosphoric acid, while inversion was carried out by adding hydrochloric acid to the liquid at 65-70° C., the flask being set aside for 15 minutes or longer.[3] At the present time the procedure prescribed by the Hawaiian Chemists' Association for use in routine work in the factories of the Territory is a slight modification of Herzfeld's method, clarification being effected with a *solution* of basic lead acetate; the direct reading read in the medium made alkaline by the excess of basic salt present; and inversion carried out at 69° C. for five minutes. Mr. BRODIE has now carefully compared the results given by these two methods, using "artificial molasses" solutions containing sucrose (in known amount), invert sugar, and "impurities" (that is, lead precipitate, washed, decomposed with hydrogen sulphide, and again filtered). His results were interesting. He found WALKER's method to give figures 0 3 to 0·5 lower than the truth, due mainly to hydrolysis of the sucrose by the excess of phosphoric acid while taking the direct reading at the laboratory temperature Another source of error (though a much smaller one) was the presence of 1·4 per cent. of moisture in the dry basic lead acetate, so that the use of 15 grms. caused a dilution of 0·2 c.c. (under the conditions of working) accounting for 0·02 or 0·03 of the difference indicated. It was shown that WALKER prescribed a much greater amount of phosphoric acid than was necessary to precipitate the lead from solution and to restore the rotation of the levulose. When half the quantity recommended by WALKER (*i.e.* 10 instead of 20 c.c. of a solution containing 100 grms. per litre) was employed, the results obtained were correct within the limit of experimental error. As to the H. C. A. method, it is considered to give results *higher* than the truth by 0·2 to 0·4 per cent., due to the volume of lead precipitate. Concluding his paper, Mr. BRODIE stated that he regards WALKER's method when modified in the manner indicated (that is using half the prescribed amount of phosphoric acid) as preferable to the H. C. A. method now in use. It eliminates the error due to the lead precipitate (HORNE's dry basic lead acetate being used); it gives a light coloured solution for the direct polarization (which is not always the case when other methods are followed); and lastly it enables the inversion reading to be made in a ½ instead of in a ⅝ normal solution.

RESULTS OF FIELD EXPERIMENTS WITH CANE IN 1917 AND 1918. *J. Kuyper. Archief voor de Suikerindustrie in Nederlandsch-Indie, 1919, 37, 2245-2320.*

During the past year a large number of new varieties have been raised by the artificial fertilization of cane, and the results to date prove the variety EK 28 superior to any other selected. It grew best of all on most soils, its only drawback being that it does not grow so well on wet soils. On such fields the variety 247 B remains the best so far. EK 28 and EK 2 have a distinctly higher production than 247 B, the other new varieties having about the same. The characters of 38 varieties are discussed in this article. It is shown on which soil they should be planted; under which conditions they are best cultivated; and their power of resistance to drought and bad conditions. It is stated that the best varieties for Java are now EK 28, EK 2, 247 B, DI 52, 100 POJ, SW 3, and 90 F. The older black Cheribon cane has almost quite disappeared from cultivation. In regard to nitrogenous manures, sulphate of ammonia shows the best results. It is somewhat better than nitrate of potash on most soils, and always better than cyanamide. Beancakes, dried blood, animal meal, are all rather good nitrogenous manures, but less preferable. Stable manure and filter press-cake are of very low value as nitrogenous fertilizers. Stable manure is good as a phosphoric manure. Bagasse ash has some value on different types of soils. Molasses is very good on coarse sandy soils. In discussing sereh disease, the question of the use of cane cuttings from the mountains and lower regions for planting material is dealt with in detail. Tops of full-grown cane and cuttings from plant cane from higher levels have the same value if healthy. In places where sereh is prevalent one should be careful not to use tops, since these are easily attacked on bad soils. Healthy cuttings from the mountains may become diseased as well as healthy tops. Cuttings attacked by yellow stripe disease give a lower yield of sugar than healthy cuttings; though cuttings thus infected may still give a rather good crop in the case of certain varieties. Binding the cane stalks together as a measure against falling cane had no result, it being shown that as a rule the yield from these is lower than from unbound, stalks. Trashing of cane did not improve the sucrose content. Small variations in the manner of tilling the soil and in planting the canes gave on the average smaller differences of yield than the variations in production caused by meteorological conditions. One must remember, however, that the tillering of the soil and the planting of the cane is carried out in Java in a very careful manner.

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[1] *I.S.J.*, 1917, 31. [2] *I.S.J.*, 1919, 406. [3] It may therefore be regarded as a compromise between the Herzfeld and Steuerwald methods of inversion. See *I.S.J.*, 1919, 304.

EXAMINATION OF HERZFELD'S DOUBLE POLARIZATION METHOD OF DETERMINING SUCROSE, AND THE RE-ESTABLISHMENT OF THE FACTOR FOR CALCULATING THE RESULT.

Richard F. Jackson and Clara L. Gillis. Facts about Sugar, 1920, 10, No. 5, 90.

In effecting inversion in the Herzfeld modification of the double polarization method of determining sucrose, 50 c.c. of the solution, containing 5 c.c. of concentrated hydrochloric acid (1·188 sp. gr.) and 25 c.c. of water, are raised to 68-70° C. in 3 to 5 minutes maintained at that point for 5 minutes, cooled rapidly, and finally read in the 200 mm. tube, preferably at 20° C. This procedure has been examined by the authors (who are attached to the Bureau of Standards, Washington). As the result of their experiments, they come to the conclusion that a total time of heating of 4½ minutes is sufficient, and that 8 to 10 minutes as prescribed by Herzfeld is too long. They have measured the rate of the decomposition of invert sugar in the presence of hydrochloric acid at different temperatures, and have found it large enough to be the cause of "considerable error." They therefore consider a temperature of 60° C. to be more suitable than that prescribed by the German chemist.

These authors have also carried out experiments dealing with the re-establishment of the factor f in the formula for the calculation of the sucrose percentage, in which D and I are the direct and inversion readings respectively, namely $(D - I)\,100/f$. Herzfeld's value for a concentration of 13 grms. per 100 c.c. is 132·66; but "applying the conditions most suitable for obtaining complete inversion, and for avoiding the decomposition of invert sugar" they have found as the average of eight tests the factor 133·25, using 5 c.c. of 1·188 hydrochloric acid, and making the reading at 20° C. Herzfeld's value of 132·66 is concluded to be in error. It is well recognized that the presence of hydrochloric acid influences the rotation of a solution of invert sugar, and according to the authors this effect can be expressed by the formula — $32{\cdot}00 - 0{\cdot}125\,C$, in which C is the number of c.c. of 1 : 1 hydrochloric acid in 100 c.c. of solution, the temperature being 20°. Similar measurements were made with other reagents, and it was found that the effect of hydrochloric acid could be duplicated by neutral salts. Thus, 2·315 grms. of sodium chloride, 2·451 of potassium oxalate, 1·761 of calcium chloride, produce the same effect as 10 c.c. of 6·34 normal hydrochloric acid. It is therefore proposed to add 2 grms. of sodium chloride to the solution used for the direct reading, in order to eliminate the error caused by the presence of invert sugar in the product under examination. Four methods of analytical procedure have been elaborated by the authors, each of particular application. Later a bulletin giving details of their experiments will be published, the present communication being only a preliminary report.

J. P. O.

Review of Recent Patents.[1]

UNITED STATES.

Preparation of Caramel.[2] *Arnold Daniel*, of Charlottenburg, Germany. *1,316,019.* Patented, September 16th, 1919.

A carbohydrate is heated with acetic acid and a dehydrating agent, as acetic anhydride or sodium acetate. For example, 100 kg. of dry beet sugar are dissolved in a solution of 10 kg. of acetic acid (99 per cent.) containing 10 kg. of sodium acetate, and boiled for six to eight hours, or for a shorter period under pressure. Lastly, the caramel is precipitated from solution by means of sodium carbonate or sodium hydroxide.

Beet Harvesters. (1) *Robert L. Merchant. 1,315,381.* Patented, September 9th, 1919. (2) *Joseph E. Wyckoff. 1,322,389.* Patented, November 18th, 1919.

Beet Harvester. *Matsunosuke Kanzaki. 1,328,231.* Patented, January 13th.

Beet Topper. *Morgan A. Green. 1,321,737.* Patented, November 11th, 1919.

Beet Topper. *Robert J. Johnson. 1,327,760.* Patented, January 13th, 1920.

Beet-pulling Machine. *Conrad Esping. 1,323,683.* Patented, December 2nd, 1919.

Chocolate Refiners' Roll. *Alonzo L. Bausman. 1,321,801.* Patented, November 18th, 1919.

Chocolate-coating Machine. *Alonzo L. Bausman. 1,323,948.* Patented, December 2nd, 1919.

Drying Starch Solutions. *Richard W. G. Stutzke. 1,320,719.* Patented, November 4th, 1919.

Moulds for Crystallizing Sugar. *Raymond E. Daly (Assignor to the American Maize Products Co.). 1,312,308.* Patented August 5th, 1919. (Eight figures.)

A device, which the inventor terms the "sugar table," is described, the purpose of which is to provide a series of moulds with detachable sides, in order that the product may be removed in the form of slabs. The series of moulds is so arranged as to provide a maximum capacity in the smallest space, while being at the same time conveniently accessible to the workmen.

Filter-leaf Construction. *Ernest J. Sweetland. 1,323,421.* Patented, December 2nd, 1919.

Starch Adhesive. *Victor G. Bloede. 1,324,332.* Patented, December 9th, 1919.

For the production of a refined or modified starch, the raw starch is heated to a temperature approximately between 300 and 400°F. (149° and 204°C.) for 30 to 60 mins., time and temperature being so regulated that the product at the end of the operation remains practically insoluble in water.

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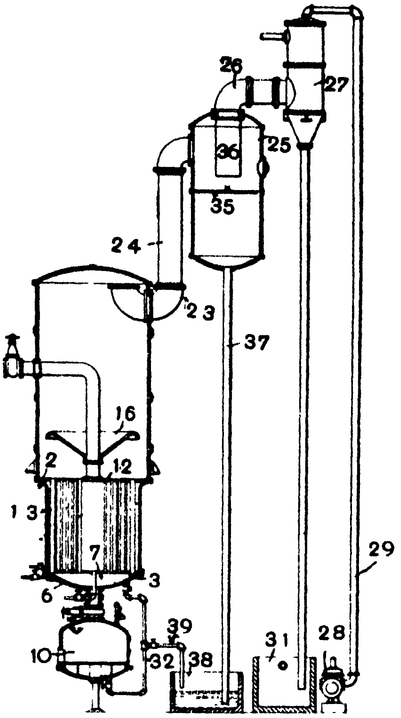
[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sale Branch, 25, Southampton Buildings, Chancery Lane, London, W.C. (price, 6d. each). *United States:* Commissioner of Patents, Washington, D.C. (price 5 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 1 fr. 05 c. each).

[2] Also U.K. Patent, 137,339.

Evaporator, providing Means for the Prevention of Entrainment. *Wm. E Garrigues and John C. Guenthner (Assignors to Wm. Garrigues & Co., Inc.,* of New York). *1,317,488.* Patented, September 30th, 1919. One figure).

In a previous patent a evaporator having a calandria provided with various improved details of construction was described.[1] In the present specification means are disclosed for the prevention of entrainment. The upper portion of the evaporator is connected by means of an elbow *23*, pipe *24*, separator *25* and pipe connexion *26* with a condenser *27*, vacuum being maintained in the system as by means of a vacuum pump *28*, connected to the condenser by a pipe *29*. The condenser is connected by a pipe to the usual hot well *31*. Liquid rising with the vapour from the inner tubes *12* of the calandria is deflected by dash plate *16* towards the periphery and falls into the outer tubes *13* in which it will descend, move towards the centre in the bottom space *7* and then rise through the inner tubes, so that there will be a continuous circulation as long as liquid remains in the apparatus. Crystals formed in the liquid will be swept along the bottom plate *6* of the evaporator toward the centre by the current of liquid and will drop into the collecting vessel *10*. The separating vessel *25* is provided with a screen *35* and has an upwardly extending pipe *36* in its upper portion leading through connexion *26* to the condenser. Vapour entering the separating chamber from connexion *24* passes through pipe *36*, while any liquid which may be carried with the vapour will fall through screen *35* and through the tube *37* extending into a liquid seal in the open vessel *38*. Pipe 37 is of sufficient length to balance the vacuum in the system, and may be filled with water. Liquid dropping through the separating chamber and pipe *37* will appear in the liquid in vessel *38* and thereby provide an indication of the manner in which the process is being carried out. Vessel *38* may be connected by pipe connexion *39*, with pipe *32*, so that when desired the liquid may be drawn into the evaporator.



Macerating Bagasse. *Charles McNeil.* *1,328,090.* Patented, January 13th, 1920; also U.K. Patent, *116,521.*[2]

Synthetic Production of Alcohol. *Theodor Lichthenhahn,* of Basle, Switzerland. *1,311,824.* Patented, July 29th, 1919.

Ethyl alcohol is obtained by the reduction of acetaldehyde with hydrogen in the presence of a catalyst ; but the hydrogen is used in such excess (at least six times the theoretical amount) that the heat of the exothermic reaction is so conducted away by this gas, and the temperature of the reaction chamber is kept at the optimum for a favourable reaction without any decomposition of acetaldehyde.

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[1] U.S. Patent, 1,289,725 ; *I.S.J.*, 1920, 60.

[2] *I.S.J.*, 1919, 41.

UNITED KINGDOM.

Two Roller Cane Mills. *John Wilson*, of Dennistoun, Glasgow. *137,357 (21,879).* Date of application, December 31st, 1918; complete accepted, January 15th, 1920. (Six figures).

In this invention the rollers, which are of equal diameter, are actuated in such a way that the peripheral surface of each pair moves at a greater speed than that of the immediately preceding pair, the first pair coming into contact with the cane having the lowest peripheral speed. In addition, each pair of rollers, when the surfaces of such rollers are plain or fluted, is so actuated that the peripheral speed of the upper roller is slightly greater than that of the lower. Referring to figures 1 and 2, it will be seen that the mill illustrated consists of three pairs of rollers. The primary power is applied to the shaft *A*, revolving at a comparatively high speed, and is transmitted to the shaft *B* through the reduction gear wheels *C*, *D*, *E*, and *F*, the final speed of the shaft *B*, being that at which the centre crushing roller rotates. Between the wheel *F* and the mill roller, a toothed pinion *G* is interposed, on the shaft *B*. Gearing with this pinion are two idle pnions *I* and *J*, these gearing in turn with pinions *K* and *L* respectively. The shaft *B*, and the shafts keyed to the pinions *K* and *L*, are continued beyond the bearings in which they are carried, at the end next to the crushing rollers, so that they can be connected thereto by the usual tail bar and coupling boxes. The bearings, which support the shafts attached to the gear wheels mentioned, rest upon mild steel channels *H*, which are erected at an angle to the horizontal plane, corresponding to the angle at which the crushing rollers are set up. The number of the teeth in the pinion *K* is less, and those in the pinion *L* greater, than that in the pinion *G*. The intervening idle pinions *I* and *J*, have the requisite number of teeth to bring the centres of the pinions *K* and *L* into a line coinciding with that of the respective rollers which they actuate. The variation in the number of teeth of the pinions *K*, *G*, and *L* is so arranged as to give the desired variation to the peripheral speed of the crushing rollers, this being accelerated as the crushing progresses. If the number of crushing rollers employed be more than three pairs, the power is transmitted through the primary reducing gear to an additional pinion similar to pinion *G*, and distributed therefrom to the extrarollers in the same manner as described.

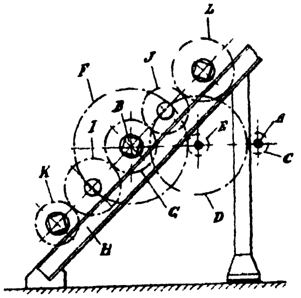


Fig. 1

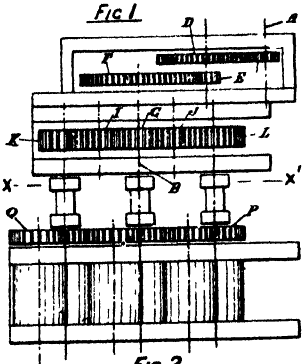


Fig. 2

Decolorizing Sugar Liquors by Filtration through Alumina or Magnesia. *John J. Hood, John Clark, and Percy G. Clark. 134,607 (18,042).* Application date, November 4th, 1918; complete accepted, November 4th, 1919.

Sugar liquors are decolorized and freed from mineral substances by means of granulated alumina or magnesia. The precipitated hydrates of aluminium and magnesium may be used, or analogous substances occurring naturally, such as bauxite or magnesite. In any case, the material is ignited and granulated, and may be mixed, before ignition, with carbon or carbonaceous materials. The liquors to be treated may be filtered through the material, or agitated with it, and filtered in a filter-press. Aluminium nitrate or chloride, or calcium or sodium phosphate may be added to the liquor before treatment. When the efficiency of the decolorizing agent has become exhausted, it is washed free of sugar, and re-ignited to dull redness with exclusion of air.

EVAPORATION OF SYRUP FOR THE PRODUCTION OF POWDERED SUGAR. *Edward Shaw.* *136,651 (21,286).* Date of application, December 19th, 1918; complete accepted, December 19th, 1919. (Three figures).

This invention concerns evaporating apparatus of the type in which the liquid is forced through a spiral passage surrounded by an outer wall which is heated by a steam jacket.[1] When using apparatus of this kind, althoughhighly satisfactory for treating many liquids in the case of some a deposit is likely to form on the outer heated wall, which on becoming overheated results in the colour or flavour of the preparation being impaired. Therefore, the outer heated wall is provided with a scraper. The spiral passage is formed between inner and outer tubes *a*, *b*, Fig. 1, by a spiral web *e* on the inner tube *c*, and the tube *b* is heated by a jacket *f*, as shown in horizontal section in Fig. 3. The scrapers *a* consist of slightly curved strips of spring steel loosely connected to web *c* by pins *e*. The inner tube with the attached scrapers is rotated or oscillated about its axis, *e.g.* by means of worm gearing *l*, *m*. The liquid flows downwards through the spiral passage into a separating chamber, from which the steam is withdrawn through the tube *a*.

FIG.1

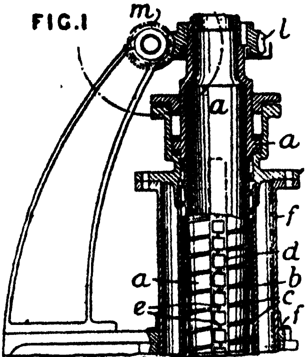
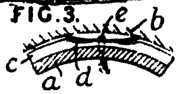


FIG.3.



PRODUCTION OF GLYCERIN BY FERMENTATION.[2] *John R. Eoff,* of Washington, U.S.A. *133,374 (11,948).* Date of application, July 21st, 1918; complete accepted, October 16th, 1919.

FILTER PRESS PLATE. *William O. Mason.* *134 415 (21,231).* Date of application, December 19th, 1918; complete accepted, November 6th, 1919. (Two figures).

FILTER-PRESSES. *Ralph W. Webster.* *135,976 (21,057).* Date of application, December 17th, 1918; complete accepted, December 11th, 1919. (Eight figures).

COOLING CHOCOLATE, COCOA BUTTER, ETC. *Emile L. A. Savy.* *124,196 (4047).* Application date, February 18th, 1919; complete accepted, November 6th, 1919; convention date (France), March 13th, 1918. (Six figures).

CONFECTIONERY INSTALLATION. *David McGregor Stewart,* of Glasgow. *137,263 (21,708).* Date of application, September 4th, 1919; complete accepted, January 8th, 1920. (Two figures.)

In regard to a confectionery dipping installation, claim is made for the disposition of the pot-heating media in a conduit, the outlet end of which leads to the atmosphere, and the inlet end of which is associated with a draught-promoting fan. Lateral walls of the conduit serve to fence the burners from the operation.

PRODUCTION OF AN IMPROVED FERTILIZER. *Paul Radmann,* of Stockholm, Sweden. *137,171 (5477).* Date of application, March 5th, 1919; complete accepted, January 8th, 1920.

Claim is made for a method of making a fertilizer, consisting in heating a mixture of mineral substance containing alkalis, especially potash (as felspar), gypsum, and limestone, in the proportion of 1 : 0·25 to 1·0 : 3 respectively to a temperature of 1000 to 1250 ° C., that is, below the point at which this mixture fuses. Instead of washing out the soluble alkali, the mass is disintegrated and applied in this condition.

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[1] See also *I.S.J.*, 1916, 195; 1919, 627.

[2] See also U. S. Patent, 1,288,398; *I.S.J.*, 1919, 471.

Heating or Cooling Chocolate. *Jos. Baker & Sons, Ltd., and Wm. E. Prescott,* of London. *131,495* (*15,766*). Date of application, September 27th, 1918; complete accepted, August 28th, 1919. (Four figures).

Manufacture of Alcohol from Acetaldehyde. *Elektrizitätswerk Lonza.* *134,521* (*19,573*). Date of application, August 8th, 1919; complete accepted. December 11th, 1919; convention date (Switzerland), October 27th, 1918.

It is known that alcohol is made by passing vapoours of acetaldehyde and hydrogen over a contact body, and if care be taken to exclude acetic acid or substances likely to form it, as oxygen, a particularly high yield may be obtained. However, if all oxygen be excluded the alcohol produced contains ether, which is objectionable when the spirit is intended for certain purposes. In this specification it is claimed that this difficulty may be avoided by passing over the contact body a mixture of acetaldehyde, excess of hydrogen, and up to 0·3 per cent. of oxygen, after which the process proceeds according to that described previously[1], that is, removing the heat of reaction (at least in part) and after separating the alcohol formed returning the excess of hydrogen to the operation by means of a circulating device.

Fermentation of Cellulose *Power Gas Corporation, Ltd., and Herbert Langwell.* *134,265* (*15,942*). Date of application, October 1st, 1918; complete accepted, November 3rd, 1919.

Under the following five conditions the fermentation of cellulose is sufficiently complete and rapid to be used for the manufacture of acetic acid, combustible gases, ammonia, etc.:—(1) The mass is aerated; (2) the natural symbiosis of organisms is maintained by correct inoculation and agitation or insulation; (3) the mass is kept substantially neutral (as by the presence of calcium carbonate); (4) the correct temperature and other factors are maintained; and (5) a vigorous fermentation is produced at the beginning by adding a soluble carbohydrate as a "primer."

UNITED KINGDOM COMPLETE SPECIFICATION ACCEPTED.[2]

Manufacture of Glycerin from Sugar *Vereinigte Chemische Werke Akt.-Ges.* *138,099; 138,328-31 (1841; 1974-77).* April 12th, 1915; April 22nd, 1916.

Filter-Presses. *Soc. Anon. des Etablissements A. Olier.* *138,317 (31,928).* January 31st, 1919.

Filters. *A. R. Peck.* *138,657* (*17,256*). October 22nd, 1918.

Evaporators. *Metallbank u. Metallurgische Ges.* *138,871* (*3895*). February 27th, 1915.

Heat-Interchangers. *Griscom-Russel Co.* *138,870* (*3830*). February 8th, 1919.

Rectifying Apparatus. *E. Barbet et Fils et Cie.* *138,869* (*3707*). February 8th, 1919.

Treatment of Fibrous Plants for Conversion into Cellulose for Paper Making. *Soc. Anon. des Etabl. A. Olier.* *138,911* (*4213*). February 11th, 1919.

Manufacture of Decolorizing Carbon. *C. S. Hudson.* *139,156.* February 15th, 1919.

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[1] United Kingdom Patent, 120,163, see also *I.S.J.*, 1919, 141, 144, 524.

[2] The date given is that of application. [3] United Kingdom Patent, 16,198 of 1914.

The Sugar Consumption of the United Kingdom.

The Royal Commission's Distribution.

Below we give figures compiled by the Royal Commission on the Sugar Supply, showing the consumption of sugar in the United Kingdom during the last three years. These figures do not quite tally with those supplied by the Board of Trade in their monthly statistics, as given on page 63 of our January issue; but it will be noticed that privately imported sugar is not included in the total while nearly 20,000 tons of sugar is included in 1919 though only allotted in 1920. However the total in each set of figures does not differ by more than a few thousand tons.

For	1915 TONS	1918 TONS	1919 TONS
Domestic use, Catering, etc.	1,194,000	579,288	790,881
War Office and Air Ministry	44,000	82,068	23,215
Admiralty	12,000	8,092	—
Navy and Army Canteen Board	—	4,580	2,474
Wholesale Jam Manufacturers	130,000	216,828	200,552
Condensed Milk	20,000	21,368	24,964
Drug Manufacture	6,834	3,417	7,490
Confectionery	151,632	41,750	166,198
Pastries	60,172	15,043	65,952
Biscuits	22,368	5,592	24,517
Candied Peel	4,612	1,153	5,055
Mineral Water	20,800	5,200	22,798
Other Beverages (Excl. Beer)	7,380	1,845	8,089
Other Manufactures	32,224	8,056	35,320
Domestic Preserving	(In Domestic)	18,012	64,459
Syrup Manufacture	39,257	74,496	68,056
Brewing	73,209	22,049	50,855
Sales without vouchers, losses, etc.	—	1,068	34,129
	1,818,488	1,109,905	1,595,004

Notes.

1915.—These figures are based primarily upon the results of the enquiry instituted at the inception of the rationing scheme.

1918.—These figures are the result of the first year's rationing, and cover the period 31st December, 1917—28th December, 1918.

1919.—These figures are the result of the second year's rationing, and cover the period 30th December, 1918—27th December, 1919, and include 19,526 tons the allotment of which was delayed until 1920.

Domestic Ration.

30th December, 1918 — 25th January, 1919 — 8 oz. weekly
27th January, 1919 — 27th September, 1919 — 12 oz. weekly
29th September, 1919 — 11th October, 1919 — 6 oz. weekly
13th October, 1919 — 27th December, 1919 — 8 oz. weekly
Average 10·61 oz.

Privately imported sugar, sold for manufacturing purposes other than Syrup and Invert making, is not included.

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

	One Month ending February 29th.		Two Months ending February 29th.	
	1919. Tons.	1920. Tons.	1919. Tons.	1920. Tons.
UNREFINED SUGARS.				
Russia	....	....	....	....
Germany	....	....	....	....
Netherlands	....	....	....	....
Belgium	....	....	....	....
France	....	....	....	....
Austria-Hungary	....	....	....	....
Java	3,839	....	7,299	148
Philippine Islands	....	....	....	....
Cuba	11,365	48,162	60,201	76,319
Dutch Guiana	509	....	927	....
Hayti and San Domingo	....	....	....	....
Mexico	....	....	....	....
Peru	3,477	2,260	12,616	12,485
Brazil	....	2,618	....	4,024
Mauritius	18,464	44,811	35,286	55,291
British India	....	148	....	1,386
Straits Settlements	....	....	....	....
British West Indies, British Guiana & British Honduras	244	6,007	1,764	10,212
Other Countries	....	3.684	12	4,605
Total Raw Sugars	**37,898**	**107,690**	**108,105**	**163,470**
REFINED SUGARS.				
Russia	....	....	....	....
Germany	....	....	....	125
Netherlands	....	11	....	982
Belgium	....	211	....	293
France	15	1	16	1
Austria-Hungary	....	....	....	19
Java	3,532	7	3,532	7,420
United States of America	13,978	11,967	26,727	44,422
Argentine Republic	4	1	6	2
Mauritius	....	....	....	....
Other Countries	100	1,904	139	6,741
Total Refined Sugars	**17,629**	**14,102**	**30,421**	**60,005**
Molasses	14,272	6,628	16,643	13,555
Total Imports	**69,799**	**128,420**	**155,169**	**237,030**

EXPORTS.

	Tons.	Tons.	Tons.	Tons.
BRITISH REFINED SUGARS.				
Denmark	....	....	....	....
Netherlands	....	1	....	2
Portugal, Azores, and Madeira	....	....	....	....
Italy	....	....	....	....
Canada	....	....	....	....
Other Countries	97	27	203	56
	97	28	203	58
FOREIGN & COLONIAL SUGARS.				
Refined and Candy	30	101	30	331
Unrefined	38	5	57	1,228
Various Mixed in Bond	....	....	....	....
Molasses	3	90	10	478
Total Exports	**168**	**224**	**300**	**2,095**

Weights calculated to the nearest ton.

United States.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1920. Tons.		1919 Tons.
Total Receipts January 1st to February 19th ..	390,420	..	329,279
Deliveries ,, ...	390,420	..	329,279
Importers' Stocks, February 18th	—	..	—
Total Stocks, February 18th	67,852	..	52,769
Stocks in Cuba, February 18th	282,198	..	386,140
	1919.		1918.
Total Consumption for twelve months	4,067,671	..	3,495,606

Beet Crops of Europe.

(Willett & Gray's Estimates to February 11th, 1920.)

	Harvesting Period.	1919-20. Tons.	1918-19. Tons.	1917-18. Tons.
Germany	Sept.-Jan...	750,000	1,411,900	1,541,061
Czecho-Slovakia, Hungary and Austria	Sept.-Jan...	700,000	700,000	668,250
France	Sept.-Jan...	170,000	110,096	200,265
Belgium	Sept.-Jan...	125,000	75,000	131,000
Holland	Sept.-Jan...	200,000	173,436	199,295
Russia (Ukraine, Poland, etc.)	Sept.-Jan...	350,000	700,000	1,028,580
Sweden	Sept.-Jan. .	150,000	127,467	125,000
Denmark	Sept.-Jan...	160,000	144,600	136,800
Italy	Sept.-Jan...	150,000	100,000	100,000
Spain	Sept.-Jan...	120,000	135,000	134,955
Switzerland	Sept.-Jan...	4,000	4,000	4,000
Bulgaria	Sept.-Jan...	15,000	16,000	22,000
		2,894,000	3,697,499	4,291,206

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR TWO MONTHS ENDING FEBRUARY 29TH, 1913, 1919, 1920.

	IMPORTS.			EXPORTS (Foreign)		
	1913. Tons.	1919. Tons.	1920. Tons.	1913. Tons.	1919. Tons.	1920. Tons.
Refined	126,736	30,421	60,005	219	30	331
Raw	130,367	108,105	163,470	544	57	1,228
Molasses	16,209	16,643	13,555	71	10	478
	273,312	155,169	237,030	834	97	2,037

	HOME CONSUMPTION.		
	1913. Tons.	1919. Tons.	1920. Tons.
Refined	122,755	22,867	46,421
Refined (in Bond) in the United Kingdom	113,892	133,650	103,532
Raw	17,099	42,151	65,639
Molasses	5,137	3,842	8,342
Molasses, manufactured (in Bond) in United Kingdom ..	6,661	12,807	12,355
Total	265,544	215,317	236,289
Less Exports of British Refined	4,193	203	58
	261,351	215,114	236,231

Sugar Market Report.

Our last Report was dated 12th January, 1920.

Whilst the Royal Commission's price of 66s. per cwt., duty-paid for granulated Crushed and White Pieces delivered for Domestic Consumption and Jam Manufacture has remained unchanged, an advance of 10s. per cwt., viz. : to 110s., has been established by the Commission for similar sugars allocated for other manufacturing purposes.

The maximum price for "free sugar" (i.e., arrived and to be imported under contracts originally made prior to 31st October last), has been raised from 115s. to 120s. per cwt., and recent Spot transactions include American Granulated at 120s., White Madagascars at 119s., and White Mauritius at 117s. 6d. The demand for the moment is very restricted, but the quantity of "free sugars" now held by Dealers, etc., must be comparatively unimportant. It is interesting to note that deliveries during 1919 by the Royal Commission to the buyers for whom such sugars are available totalled some 360,000 tons, and that the basis of present issues under this heading is only 50 per cent. of the 1915 allotments, which percentage, calculated for the whole year, would give about 160,000 tons, leaving an apparent shortage of about 200,000 tons in comparison with last year.

During the strikes in Cuba, extravagant prices were paid for any available raw sugars; a considerable speculative bull engagement which already existed was probably increased, with the inevitable result that the cessation of the strikes, and the consequent freer movement of sugar, occasioned a desire to realize, under which prices collapsed, a reported sale of Porto Ricos at the parity of about 8 cents. f.o.b. for Cubans marking the limit of the decline. It is believed that during the period of weakness the Royal Commission secured substantial quantities of Cubans; the American refiners also profited by the occasion to clear the market of many weakly held parcels afloat to U S.A. ports. A quick recovery in values has ensued, and the tone of the New York market is firm, with Cubans quoted at 9 75 to 10·00 cents f.o.b. for March, April, and May deliveries.

Quotations in Java for near deliveries are prohibitive, and the exportable balance of the present crop almost negligible. European markets will scarcely be attracted by the present quotation of about 95s. f o.b. for whites, plus the ruling freight of 10s. to 12s per cwt. Owing to the exhausted stocks referred to, the East will be deprived of anything but insignificant shipments over the next three months, and will be prepared to take care of the early new crop production, say May/June, and perhaps even a considerable portion of the July outturn, seeing that the Crop is backward and likely to be late in starting. The bulk of the new crop has passed out of "first hands" from whom nothing is now obtainable for delivery earlier than September/October, the quotation for those months being about 74s. to 75s. f.o.b. for whites. Some business to India was recently reported at the parity of about 78s. f.o.b. August/September shipment, but values have since declined 3s. to 4s. per cwt. concurrently with the weakness in Cuba.

In France, Belgium and Holland, arrangements have been definitely made for increased beet sowings. Reports from Germany are conflicting; whilst certain private advices predict increased cultivation of some importance, official statements speak of hesitation on the part of many cultivators to augment production, owing to fears of a repetition of the labour scarcity encountered during the present campaign. It is reported from Magdeburg, under date 28th February, that Government proposals to fix higher minimum prices for potatoes, wheat, rye and other cereals "have been the signal for farmers to raise at once their protensions for growing roots, for they ask now 16 to 18 marks per centner of roots (an advance of 3 to 5 marks per centner); of course, this means a great difference, and may obviate any, or a great part, of the intended increase in beet sowings."

The 1919/20 crop in Czecho-Slovakia suffered severely from adverse weather, resulting in an outturn much below anticipations; an extended acreage will be planted for next campaign and if favoured with a normal growing season, the coming crop should yield a substantial surplus for export.

By the middle of May, estimates of European sowings (more or less reliable) will be issued by factories and Mr. Licht, which will afford a clearer basis for calculation.

H. H. Hancock & Co.

10 & 11, Mincing Lane,
London, E.C. 3,
March 9th, 1920.

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

Notes and Comments.

The Kelham Sugar Beet Scheme.

As will be seen from the details on another page, the company to carry on the Kelham estate as a beet sugar venture has at length been launched, and a beginning is intended to be made next year with the growing of roots for the new factory which will thus inaugurate its first "campaign" in the autumn of 1921. The most striking financial feature of the new scheme is the extent to which the Government have not only taken shares in it, but have also guaranteed a dividend to the public shares for ten years to come. This is both a measure of the importance the Government attach to the experiment, and also we think of the confidence they show in its probability of success. With this strong backing, there seems no legitimate reason why the factory should not pay, always providing the producers of the raw material, the farmers, can be persuaded to realize the importance and the profitableness of growing sugar beets as a primary crop in rotation with others.

At the same time we are still without any details as to the *modus operandi* to be adopted in this factory. Nothing is said as yet by the promoters as to the procedure and the particular apparatus they intend to install. The general public of course are not interested in these matters, but the world-wide circle of sugar industrialists does take an interest in these points, and would be glad to know the technicalities of this much heralded beet factory. All they can conclude from the information yet allowed to be published is that since a French expert has been appointed to supervise the technical side French practice will be followed.

One thing does however emerge from the publication of the prospectus and that is the very moderate dimensions of the new factory. Its capacity has been provisionally fixed at about 600 tons of roots per diem, or 20 per cent. above the minimum capacity found profitable in the United States, viz., 500 tons. The sugar production is expected to be about 8000 tons. Needless to say whatever the value of the factory as an experiment in proving the practicability of beet sugar production in this country, its contribution to the consumption is infinitesimal. That being so, we think there has been little justification for the extent to which the parent society has worked up the public by its exuberant propaganda of the last two or three years. This project has been boomed in the daily press at regular intervals for a long while past till the public might be pardoned for supposing that it was going to be a very big affair and make a considerable difference to the sugar supply of the country. As an instance of what the public were told, one speaker enthused on the fact that this factory was to turn out enough to supply half a million people with sugar—just the sort of vague statement to lead to exaggerated anticipations.

The plain fact is that this factory in spite of all the impressive advance advertising it has received is only a very small beginning in an interesting experiment with which the Government—rightly enough—associate themselves. We welcome the trial, since we have for the last 20 years advocated it persistently in our pages. But it would have shown a far nicer sense of proportion if much less had been said about the venture in the public press and more expedition had been made in putting the experiment into practice, since the days five years ago when the country realized for once fully its inconvenient dependence on enemy countries for the bulk of its sugar supply. As it is, three years are being allowed to elapse between the Armistice and the day when the factory starts slicing. And when it does, the result to the sugar production of the world will be so small that not a single cane sugar producer need worry about increasing his own crop as much as possible. In practical sugar politics Kelham is only an experiment (with some ultimate possibilities if its assumed success is vigorously followed up) and not a serious contribution to the much needed sugar supply, although to judge by the amount that has been published about it the sugar world might have been led to suppose otherwise.

Cantley Factory to Re-open.

Simultaneously with the activity displayed in connexion with Kelham, news comes to hand of the projected re-opening of Cantley factory under new proprietorship provided the necessary support from the farmers is forthcoming in the shape of 3000 acres sown with beets. This factory has been bought from the English Beet Sugar Corporation by Messrs. GRAHAM, SON & HAY, a firm of Liverpool sugar merchants, who intend to run the factory in conjunction with Mr. VAN ROSSUM, a leading Dutch sugar manufacturer (who was associated with the original Cantley scheme). Besides working as a raw beet sugar factory during the autumn, it is intended that the factory shall also be equipped with refining apparatus working the Norit process, so that for the remaining months of the year cane sugars can be refined for the home market. But everything depends on the response of the East Anglian farmers, and at a meeting held in Norwich at the beginning of March the position was carefully placed before them and a strong plea made for their co-operation. We understand that a considerable acreage was promised in consequence.

At this meeting (according to the *East Anglian Times*) it was stated that if insufficient acreage was forthcoming, the purchase by the new owners would be cancelled and the factory be finally dismantled and its machinery sold to either Kelham or Cuba. Too many advantageous offers had been made for the Cantley plant to make it worth while continuing to hold it in a derelict condition. They were offering the farmers £4 per ton for their roots and at this price it ought to pay to grown the beets. One speaker thought there would be a gross return of £40 or even £50 to the acre at this rate. If the new venture succeeds in getting the necessary support from the growers, there seems no reason why the factory should not become a paying concern and add to this country's refining capacity.

If Kelham is to be under a French technicist, it would appear that Cantley is to be under Dutch supervision as far as the technical side is concerned, since it is intended that Dutch chemists and sugar boilers shall be employed at all events at the start. The trial of the Norit process (a Dutch invention) should also go some way to establish its utility in this country. We only wish that there was also a third factory in existence, or at least projected, at which the best American practice could be tried out.

Payment for Mauritius Sugar.

According to the *Times Trade Supplement*, the diverting of the bulk of the Mauritius sugar crop from India to the United Kingdom has raised considerable difficulties in the matter of financing the purchases. Neither of the local Mauritius banks has either enough paper money or silver rupees to meet payments which as far as the sugar crop was concerned averaged in 1919 Rs.120,000,000. The result has been that large sums standing to the credit of the Mauritius planters have for some months been lying unused in two London banks. Should the Sugar Commission decide this year to buy the colony's output, the sums will be augmented still further. Relief could be obtained either by the importation into the island of several million rupees or by raising the capital of the local banks. But the former proposal is barred by the fact that India prohibits the export of rupees. Most of the planters have used part of the money standing to their credit in London to pay for new machinery acquired in Great Britain for their factories, but these payments, amounting in round figures to Rs. 3,000,000 out of a total of Rs. 25,000,000 which is approximately the sum standing to their credit in London, have in no way solved the problem.

The Cuba Sugar Crop.

The harvesting of the Cuban sugar crop may now be said to be more than half-way on. But reports coming in from all parts are quite disappointing as regards tonnage of cane per acre. Before the harvesting started, fields looked well and indications of a good crop were then favourable. It was known that the lack of sufficient rain in the latter part of last year would account for a certain shortage in the tonnage, but it was hoped that good healthy showers would bring on the fields due to be cut from February onwards. These expectations have not been fulfilled and therefore the verdict to-day is: "light tonnage."

It is difficult to say at the moment just what the shortage will be. From many reliable sources it is stated to be 30 per cent. under last year's figures, and in some instances 30 per cent. under this year's estimates. What is certain is that a large number of factories will end their crop much earlier than they had expected to do, and their output will be much less than previously estimated.

On the other hand it is the case that in certain districts larger areas of cane will be reaped, and this will off-set to a certain extent the shortage of cane per unit area, but it is impossible to say as yet to what extent this will affect the estimates made at the end of last year. As the harvesting goes on, the real situation will become more and more evident, and one is safe in affirming that the previous estimates are too high, and the output of many a factory will be disappointing. Guma & Mejer's estimate dated December 24th (but only just issued owing to a printer's strike in Havana) put the crop at 4,435,714 long tons.

The difficulty of getting early delivery of the machinery necessary for the manufacture of plantation white sugar is delaying somewhat the production of that article on some of the Cuban estates. However, as soon as the necessary machinery is installed manufacturing will proceed. The system to be generally used is what is commonly called the double-sulphitation process, and most of the machinery is being supplied by the well-known New Orleans firm of Harry Brothers Company, who are at this moment putting up five or six installations.

Alien Labour Strikes in Hawaii.

Labour troubles have been very prevalent in the Hawaiian sugar industry the last few months, especially amongst the alien workers—Japanese and Filipinos. They appear to have been largely the work of labour agitators since it is hardly suggested that the rate of pay in Hawaii is insufficient for this class of work. There they have a bonus system in force which increases the pay in exact proportion to the advance in the price of sugar, and under existing sugar prices, the extra pay being received by this labour is fully two and a half times the normal rate of wages. In addition, free housing, free medical attendance and other special compensations are given them.

According to *Facts about Sugar* the feature of the strike is not dissatisfaction with pay and conditions of employment, so much as the attempt on the part of the Japanese Federation of Labour to exact obedience to their arbitrary dictation. It is asserted that this organization uses the claim that its course has the support of official and private interests in Japan as a means of intimidating the labourers. Pressure of many kinds is alleged to be applied in order to force obedience to the orders of the labour agitators, the labourers being told, for example, that if they decline to leave their jobs their names will be reported to the authorities of their native towns in Japan and their families will be liable to be ostracized in consequence. There is no evidence of course that the Japanese Government are in any way responsible for this stirring up of trouble in Hawaii; their attitude has been perfectly neutral so far, but if the facts as alleged prove correct, it may yet be necessary for them to interfere and define, if not limit, the actual powers of the Japanese Federation of Labour. Meanwhile the attitude of the Hawaiian Sugar Planters' Association is that it is necessary to oppose the strike movement to a finish at any cost. The Association has publicly stated that it sees in the action of the Japanese Federation of Labour an anti-American movement designed to control the sugar business of the Hawaiian Islands.

Racial trouble with Japanese immigrants is of course no new experience in America and years ago led to some rather estranged relations between America and Japan over the presence of Japanese settlers on the American Pacific coast. We believe the war dispelled for the time being this attitude; it will therefore be unfortunate if there is a recrudescence of ill-feeling between these two nations on the strength of an international labour dispute in Hawaii. At the same time the latter would seem to need some careful handling; we hardly suppose the fact can be ignored that the Japanese workers in this case went to Hawaii with the full approval of the sugar industry there, to help to make up a shortage of labour, and now more than a third of the population of the Hawaiian Islands is Japanese.[1] But this case only illustrates the inconvenience of an industry being so dependent on alien labour at the present moment when everywhere there is an effort being made to re-adjust the relations between capital and labour. Most countries have enough trouble with their indigenous labour demands without wishing to be involved in a dispute with labour of an alien origin that has settled within their borders and will not accept the existing order of things.

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[1] In 1915 there were 93,136 Japanese in Hawaii out of a total population of 232,856.

Notes and Comments.

The U.S.A. 1919-20 Beet Crop.

It is unfortunate that when there is a world's scarcity of sugar, the American beet crop just ended should prove on the short side; it has turned out the smallest crop in seven years. Figures supplied by the Meinrath Brokerage Company of Chicago place the total production for the 1919-20 campaign at 14,526,749 bags or 726,337 short tons (648,511 long tons). As compared with 1918-19 the decrease shown is 36,099 short tons or 4·7 per cent., but the decrease over the earlier estimates made last summer is more serious, being about 142,500 tons or more than 16 per cent. The difference between the estimates and the actual crop has therefore been unusually high. The cause of the shrinkage, which amounted to as much as 20 per cent. in certain states, was due to the early setting in of severe winter weather.

Czecho-Slovak Industry.

A Czech Society of Great Britain has been formed to work for close relations between Great Britain and the Czecho-Slovak Republic in the political, artistic, intellectual, and economic field. Lord Robert Cecil, M.P., is president, and the offices are at 17, Buckingham Palace Road, London, S.W.1. In a sketch of Czech civilization issued by the Society, it is pointed out that during the years 1906-10 Bohemia and Moravia produced 46 per cent. of the total amount of grain grown in Austria, 93 per cent. of the beet sugar, 44 per cent. of the clover and fodder, and 41 per cent. of the potatoes, though these lands represent only 26·4 per cent. of the territory of the late Austrian Empire and but 35·50 per cent. of its inhabitants.

German Propaganda.

H.M. Consul-General in New York reports that Germany is making serious efforts to regain her foreign markets and is about to flood foreign countries with German periodicals. A manufacturers' export paper published in four languages—German, English, French, and Spanish—is now being published to which German engineering firms are subscribing heavily in the shape of advertising contracts and prepaid subscriptions on behalf of a large foreign circulation during a period of five years. Individual firms like Krupp's have contracted to pay the fees for over 3000 free copies to be sent out regularly during that period. Further a combination or trust of the German industrial press is in course of formation with a view to making concerted efforts in the same direction. The export paper above referred to is under the management of the "Allgemeine Anzeiger Gesellschaft m.b.h.," known for short as the "Ala," a notorious propaganda centre of German war industry.

It is reported that the Luce cane harvester has been found satisfactory on the estate of the Central Mercedes, Guareiras, Cuba, and that another of these machines has been ordered.

Dr. W. D. Horne[1] published a set of analyses of Cuban sugars received during the past two decades at one of the Atlantic refineries. These tables show that during the past few years, sugars of this class have averaged a little above 95·5° polarization, 0·6 per cent. of ash, about 1·3 per cent. of glucose, and a trifle less organic matter, while the moisture content has been a little more than 1·1 per cent. Dr. Horne comments that these "figures are fairly satisfactory, indicating the composition of a sugar which keeps well on storage and which can be refined with satisfactory results . . . . . In the effort to produce a vast quantity, Cuba, as a rule, is maintaining a good quality[2] . . . ."

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[1] *Facts about Sugar*, 1920, 10, No. 12.230.

[2] Compare *I.S.J.*, 1919, 462, 464.

Fifty Years Ago.

From the "Sugar Cane," April, 1870.

In this issue of our predecessor, there appeared an article on a process that was expected "to eventually revolutionize the industry of Europe and the colonies." This was the sucrate of lime process, advocated by ROUSSEAU, whose name is closely identified with the history of the carbonatation method of clarification. "As raw material for the manufacture of sugar, the sucrate may be warehoused or transported, and may take its place on the markets. The quantity of lime it contains will not make the expense of carriage greater than that of raw sugar. The *usines* situated at considerable distances from the farms may be supplied with sucrate instead of beets, and thus the work of manufacture may be carried on during the summer." In the article under notice, which was a translation from the *Journal d'Agriculture pratique*, directions were given for the preparation of the insoluble compound of sugar on a small scale on the farm at home or on the plantation abroad; while details were also given for the procedure to be followed for the decomposition of the sucrate in the carbonatation tanks. In conclusion the anonymous author stated that if the process were adopted the filtration of the syrups through animal charcoal, as was largely followed in many of the factories of that time, no longer became necessary. Incidentally in this article it is mentioned that ROUSSEAU had invented a new decolorizing charcoal "the cost of which was so low that it might be utilized as manure, or even thrown away after use, instead of being revivified. . . . . . Careful study of the properties of bone charcoal had convinced him that the decolorizing power resides essentially in the nitrogenous matter. He therefore replaced the framework of the char by clay, which he calcined with 25 per cent. of other matters . . ."

Another process, of which great things were anticipated by those advocating it, was that of osmosis. It is shown in an article appearing in this number that DUBRUNFAUT had placed the method of separating the salts from molasses solutions by osmosis (previously suggested by DUTROCHET) on a practical basis. An apparatus was described, called an "osmogene," which was a variation of the filter-press, consisting of a series of frames between each of which was placed parchment paper. Every other compartment contained the molasses solution under treatment, the rest containing water, which, as it became charged with the salts diffusing from the layer of molasses against it, was drawn off and replaced by fresh. An experiment made with a beet molasses containing 50 per cent. of sugar and 14 per cent. of salts showed that 6 per cent. of the latter were removed when the water was changed only twice, 1 per cent. of the sugar being lost at the same time.

WILLIAM ARNOT, a refinery chemist, took M. TISSANDIER to task for advocating faulty methods of analysing animal charcoal. As was pointed out in our last issue, the French writer had stated that the carbon might be found by subtracting the moisture from the loss on burning; but it was shown that the results obtained in this way always differed appreciably (owing to the decomposition of the carbonates and to the oxidation of the ferrous oxide) from those found by solution in hydrochloric acid and the weighing of the carbon and sand on a tared filter. TISSANDIER was also corrected for determining his silica by using "water acidulated with chlorhydric acid" for dissolving the "ash"; for determining his phosphates by precipitation with ammonia; for determining his carbonates from the lime uncombined after the determination of the calcium phosphate; and lastly for omitting the determination of the iron, it being pointed out that "the iron is an essential point in the analysis of used chars, and is not to be passed lightly over even in new unused chars." Penny's process[1] was advised for its determination.

It is of some interest to note that according to an article published in this number by an anonymous writer a beetroot distillery had been established in England at Buscot Park on the Thames in Oxfordshire, the estate of a Mr. ROBERT CAMPBELL, who appears to have been an agriculturist of some enterprise. A large area (about 1600 acres) had been placed under cultivation by "steam ploughs on Mr. Fowler's principle," irrigation also being practised "on a vast scale." Extraction of the juice was accomplished by twenty presses operating on the Collett system, enabling nearly 100 tons of roots to be treated in 10 hours; while a French firm had installed two large stills and a rectifier, in addition to fermentation vats and storage tanks. Unfortunately, however, this venture, so bravely begun, proved a failure after about ten years, due principally, it is believed, to the excise duties on spirit being found to be too heavy to make the production sufficiently remunerative.

Three patents were noticed. A. M. CLARK,[2] in a communication from L. J. F. MARGUERITTE, claimed a process of treating sugar or massecuite with wood spirit while stirring, this treatment being such as to remove the molasses and after washing give "a perfectly white sugar." D. STEWART,[3] of Glasgow, described an apparatus for "concreting" of cane juice, but this patent was later abandoned. Lastly, W. HOSACK[4] gave details of a 6-roller mill, consisting of three upper and three lower rollers, each upper being placed vertically above the co-acting lower one.

The Kelham Sugar Beet Estate.

Details of the New Company and its Scheme.

Early in March the long promised Company which was to take over the Kelham interests of the British Sugar Beet Growers' Society, Ltd., was floated under the name of "Home Grown Sugar, Limited." The authorized share capital is £1,000,000 in £1 shares, and the present issue consists of 500,000 ordinary shares at par, of which 250,000 have just been offered for public subscription. The Government through the Ministry of Agriculture have agreed to assist the Company by subscribing for a number of ordinary shares (not exceeding 250,000 but equivalent to the number allotted to public subscribers), so that assuming the public allotment is fully subscribed, the Government would hold 50 per cent. of the 500,000 ordinary shares now issued. Out of the 250,000 shares offered for public subscription, the Directors of the company and their friends, members of the British Sugar Beet Growers' Society, Ltd., had already applied for the allotment of 125,000 shares, so it was only requisite for the outside public to take the balance of 125,000 shares for the issue to be complete.

The importance of the Government assistance to the scheme may be gauged not only by the fact that a sum up to half the issue has been contingently promised by the Government; but in addition, a dividend of 5 per cent. per annum upon the capital subscribed by the public up to 250,000 shares is guaranteed by the Government for a period of ten years subject to certain conditions. The immediate security of the public issue is therefore assured for that period. The Directors of the new company are largely drawn from the committee of the Society whose interests in Kelham are taken over; Sir **BEVILLE STANIER**, Bart., M.P., is the chairman of both bodies; and the Board comprises the following gentlemen: Hon. E. G. **STRUTT** (a land surveyor); Mr. D. M. **HORNE** (a partner in a firm of East India merchants); Sir **ERNEST JARDINE**, Bart.; Mr. G. L. **COURTHOPE**, M.P. (a leading agriculturist and Chairman of the Central Chamber of Agriculture, 1909); Mr. J. **MASON** (a director of a Newark engineering firm); the **EARL OF DENBIGH**; and Mr. G. H. **ROBERTS**, M.P. (late Food Controller). The last three are not on the Committee of the British Sugar Beet Growers' Society. In addition to the above, the Government so long as they hold a financial interest in the company are entitled through the Minister of Agriculture to appoint a financial representative upon the Board of Directors who will have power to veto any action proposed in respect of certain financial matters.

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[1] That is volumetrically, using potassium dichromate. Dr. FREDERICK PENNY was well known in his time as Professor of Chemistry at Andersonian's Institution, Glasgow.

[2] 2280 of 1869. [3] 2302 of 1869. [4] 2316 of 1869.

As regards the proposed division of profits, the net profits for the next ten years are to be first applied to the payment of 5 per cent. upon the public shares, the Government shares not ranking for dividend. The surplus will then be used, first for repaying the Government any interest the latter have advanced under their guarantee, and secondly in paying cumulative 5 per cent. dividends upon such number of Government shares as the directors shall elect to call upon the Minister of Agriculture to transfer to the nominees of the directors upon payment of their par value. The intention of the Government assistance is in effect to stabilize the industry during the earlier years as a profitable commercial proposition by ensuring a certain 5 per cent. dividend to the public shareholders and when so established to encourage the company to divest itself of the Government control consequent on the investment of State funds in the enterprise. For that reason the directors may at any time when their funds allow buy out any or all of the State holding.

The following particulars of the company and its parent body are taken from the prospectus lately issued to the public:—

The British Sugar Beet Growers' Society, Ltd. was registered in 1915 under the Industrial and Provident Societies Acts with rules prohibiting the division of profits among the shareholders. It consists of 158 leading agriculturists, sugar users, and others, a large number of whom are prepared to take a substantial financial interest in the Company, being satisfied as to the commercial possibilities of the industry and as to its value for the improvement of British agriculture.

Basis of the Scheme.—The scheme of operations of the Society is based upon the Kelham Estate, near Newark, Notts. The estate, originally 5603 acres, was purchased by the Society in 1917 with moneys advanced by his Majesty's Treasury from the Development Fund. On 6th April, 1919, with the approval of the Treasury and consistent with the development of the scheme, the outlying area comprising 2769 acres, was sold to the Minister of Agriculture under the Small Holdings Colonies Acts, 1916 to 1918, for the settlement of ex-soldiers and ex-sailors upon the land. The remainder (including the villages of Kelham and Averham), consisting of 2834 acres (4½ square miles), has been developed by the Society as one large farm, and will be transferred to the Company as a going concern, fully equipped with farming stock.

The Scheme.—The fundamental object of the Company is to develop and complete the scheme of the Society on national lines with the co-operation of the Government and the British Public. The scheme is as follows:—

(a) To build a factory on the Kelham Estate for the manufacture of beet sugar.

(b) To provide a market for the sugar beet crops of farmers in the surrounding districts (including the Government Settlers) thereby increasing the yield of the succeeding crops in the rotation.

(c) To provide under the control of the factory a demonstration farm on extensive lines growing sugar beet in rotation as the main crop, thus assisting in ensuring a minimum economic supply of raw material for the factory.

(d) To provide in the by-products of the factory a valuable feeding stuff for live stock, known to increase the yield of meat and milk.

(e) To assist in providing steady employment for seasonable labour.

(f) To commence a definite contribution by British labour and British capital to the sugar consumed in this country, for the whole of which the United Kingdom has hitherto been dependent upon other countries.

(g) To assist in reviving and re-creating rural life and industry.

Erection of Factory.—It is proposed to build a beet sugar factory upon the estate to be ready for receiving beet in the autumn of 1921. Its capacity has been provisionally fixed at 600 tons of roots per day. This represents approximately, on a normal campaign, the produce of about 6000 acres, a supply of roots of about 60,000 tons, and sugar production of about 8000 tons. The best expert advice will be secured so that a factory on the most modern lines will be built, giving the highest economic results in the use of coal, limestone and labour, with the maximum sugar extraction. An expert beet sugar factory manager will be appointed forthwith, and the factory will be erected with his advice and to the approval of the Government. The site upon the estate provisionally selected for the factory is on the bank of the river Trent (navigable arm) opposite Newark, where the two main lines of the Great Northern and Midland Railways join, and is near to the chief arterial road of the district. Good main roads lie in all directions on and towards the Estate. The surrounding by-roads are numerous and well metalled. The Derbyshire coalfields and limestone quarries are within easy distance for transport. An abundant supply of water is available. The estate lies in a well-known agricultural district, and in a central position as regards labour, being also in easy communication with the large market towns in the Midlands, and the Ports of Goole, Grimsby, Immingham, and Hull by rail or river.

Production of Beet.—The Estate is not intended to provide all the raw material for the factory, nor is it proposed to limit the acquisition of land for sugar beet cultivation to the Kelham Estate. The Estate will act as a reserve supply for the factory, being capable of producing about 6000 tons of sugar beet per annum as a rotation crop. The alluvial character of the agricultural land in Nottinghamshire and Lincolnshire is well known. Arable crops are satisfactorily grown and the land is suitable for live stock. Farmers in the surrounding districts will be asked to grow beet for the factory on contract. The Directors are of opinion that a full supply of sugar beet can be secured each year within an economic transport radius of the factory. Twenty-three acres of beet grown on the Kelham Estate in 1918 with three varieties of seed on land for which no special preparation was made (taken over from the outgoing tenants in a foul and impoverished condition), yielded nearly 13 tons of topped and washed roots per acre, and the analysis of samples showed a sugar content of 17 to 18½ per cent. (Dr. J. A. Voelcker, 26th November, 1918). The Directors are therefore of opinion that the average tonnage should be 10 to 12 tons per acre, and the average sugar content not less than 16 per cent. It is proposed to appoint forthwith an experienced Contracts Manager, to take charge of the supply and transport of raw material, and to organize farmers and advise them in the cultivation of beet with a high sugar content, and in the disposal of the "slices" or by-products.

Capital Requirements.—The estimated capital expenditure will be as follows:—

Kelham Estate.—Farm and accommodation lands, woodlands, farm buildings and cottages, Kelham Hall and Grounds, malt kilns, messuages, ground rents, and other properties	£129,187
Mineral Rights at two years' purchase of minimum dead rent (royalties not taken into account)	2,000
Live Stock, implements, produce and stores and tenant-right	24,267
	£155,454
Less estimated surplus in the hands of the Society (after paying its liabilities and the Preliminary expenses of the Company) to be handed over to the Company	£14,454
	£141,000
Beet Sugar Factory.—Taken at three times the estimated pre-war cost	300,000
Available Working Capital in Cash	59,000
Total Estimated Capital Requirements	£500,000

Financial Prospects of the Enterprise.—The British Sugar Beet Growers' Society, Limited, has investigated with all possible care and in consultation with experts at home and on the Continent (*a*) the cost of the cultivation of sugar beet providing a reasonable profit to the grower; (*b*) the cost of production of beet sugar in a modern factory; (*c*) the cost of transport; (*d*) the feeding value of by-products; (*e*) the proper charges for establishment, up-keep and depreciation; and (*f*) reasonable profit from the sugar beet farm under the same control as the factory; and has arrived at the following estimates:—

Expenditure.—	
Net average *maximum* cost of the production at current rates for labour and materials of 8100 tons of white granulated sugar—estimated at £44 13s. per ton delivered ex-factory duty paid at present rates	£361,665
Deduct the profit from the Estate calculated upon the basis of 6 per cent. on the value of the property with an additional 10 per cent. upon the farming capital employed	11,000
Net current annual expenditure	£350,665
Income.—	
Minimum market price of imported sugar for the next ten years—estimated at £50 per ton ex-wharf, duty paid at present rates. On 8100 tons of sugar	405,000
Balance to credit	£54,335

The *maximum* cost of producing sugar given above is expected to be materially reduced, not only by the fall in price of certain materials at present abnormal, but in the usual economies possible in an undertaking when it has been firmly established. The *minimum* market price of sugar given above, namely £50 per ton for imported sugar, duty paid, is regarded as a conservative estimate. The price of free sugar to-day ranges from £118 to £120 per ton, duty paid.

The prices of sugar in Buenos Aires, says an American Consular Report, have experienced extraordinary fluctuations in the past few years, and the height they have reached is remarkable in view of the important local production. Wholesale prices of white sugar, granulated or pulverized, in Buenos Aires market averaged 7 cents per lb., United States currency, from 1910 to 1915, inclusive. In 1916 they averaged 8 cents; in 1917, 11 cents; and in 1918, 13 cents. In 1918 sugar reached its highest figure in the month of November, when it wholesaled at 15½ cents. The average wholesale price for the first eight months of 1919 was 11·2 cents.

The Real Situation in the Continental Beet Sugar Industry.

(From a Special Correspondent.)

German sugar journals of late have contained articles on the difficulties accruing to the sugar factories by the decrease in the intrinsic value of the mark, or in other words by the ever-increasing cost of beets, materials, coal, wages, etc. Dr. CLAASSEN shows in an article in the *Deutsche Zuckerindustrie* how great the difference is between the position of a given factory a couple of years ago and now; and he gives an example of one sugar factory working up 29,000 tons of beets per campaign. Before the war the price of beets was about one mark per 50 kg. and that of sugar between 10 and 11 marks. The price of beets was gradually raised to 4 marks per 50 kg. and that of raw sugar to 53 marks; but now the price of beets has ceased to be fixed by Government, while the official basic price of raw sugar for the 1920-21 crop has been raised to 150 marks. This high rate has been fixed with a view to allowing an increase in the price for roots and thereby inducing farmers to extend their sowings. The price of beets is not yet known for the whole of Germany but in many places it fluctuates between 12 and 15 marks per 50 kg.

If we assume the sowings to be extended by 25 per cent. and the yield of sugar per hectare to increase also by 25 per cent. over last year's yield (at best only a hypothesis), 260 German sugar factories will receive from the 340,000 hectares of beet land 7,500,000 tons of roots, which assuming a yield of 15·5 per cent. will produce 1,160,000 tons of raw sugar. These figures point to an average quantity of 29,000 tons of beets to every 4500 tons of sugar per factory. Such a factory would have paid before the war 800,000 marks for the beets and the manufacturing expenses; next year, with a sugar price of 150 marks the sum will be more like 12,200,000 marks. The value of the sugar produced was in the former case 1,000,000 marks; next year it will be on the same basis 13,500,000 marks. In most cases the capital of an average factory amounts to half a million marks and could at the most be increased to double that sum, but not much more, so it is difficult to see whence the huge amount of money is to come with which to pay the enormous sums needed for purchasing the roots and for the manufacturing costs in the three or four months of the sugar campaign. If it were only one single factory the difficulty would not be so very great, but Germany posseses 260 of such establishments, all of which are in the same plight. Where before the war a sum of 210 million marks would have sufficed to meet all the expenses, nowadays about 3150 millions is needed; and where in former days the value of the sugar amounted to 250 million marks, it will now rise to say 3480 millions.

The only existing buyers are, under the present system of obligatory delivery, a group of 25 sugar refineries, which receive about 80 per cent. of the output The balance is washed white, turned out in the special granulated factories, and in small syrup or candy factories. If, during next campaign, the refineries are obliged to accept 40 per cent. of the crop during the three months October to December, they will receive each of them on an average 18,000 tons of sugar and pay 54 million marks for that quantity. The total amount of sugar to be worked up in the refinery to be divided also over the subsequent months of the year, would be 36,000 tons and the total sum to be paid 108 million marks. The refined sugar is sold gradually, so that the return from the general public comes in very slowly. The refineries or the sugar factories will have to advance these vast sums of money, while in the meantime very big amounts will have to be paid in insurance premiums and warehouse charges for this valuable commodity.

A second article in the same paper, this time signed "Sch.," relates to the difficulties from a practical point of view arising from the high beet prices. While in former years a beet grower received 1000 marks for 1000 quintals of beets, he got last year 4000 marks and now will be entitled to 12,000 marks, for the same quantity. In the case of shareholders' beets, the payment is simplified, since such people have bank accounts and may be paid by transferring the sums from one account to another. But the smaller farmers, who used to be paid cash by an employee of the factory, who came round once a week and handed over the money, will now have to open bank accounts too. If in past years the clerk had to distribute 20,000 marks, he did not encounter any difficulty in paying over that amount, but now the sum will be a matter of some 240,000 marks, and obviously it is not advisable in these days to carry so much money about the country, nor do the farmers require to have so much cash at home. It will therefore be necessary for such beet growers, who, up to now, have not felt the necessity of having a bank account, to change their methods of settling their business with the sugar factories and adopt some such clearance system in future.

On the other hand, the sugar factories will have to possess a large credit in order to enable banks to pay for all those advances on sugar to be delivered. This will not be wholly impossible so long as the price of sugar is kept fixed by the government; but, as Dr. CLAASSEN points out, the business becomes rather risky as soon as government interference with the fixation of prices ceases and the sugar trade is freed from supervision. In that case the price of sugar in Germany would rise to the world's parity, which is nowadays equivalent to 500 marks per 50 kg. of sugar and to 48 to 50 marks for the same quantity of roots. Then an average sugar factory would have to pay 38 million marks and produce sugar to the value of 45 millions, while the total sums would be 9750 million marks for expenses and 11,600 millions for receipts. An average refinery would have to lay out 150 million marks in the first months of the campaign and 375 millions in a year.

But the price of sugar is liable to very great fluctuations and the banks will not too readily accept it as mortgage for the immense sums needed. It is therefore not at all clear whence the money will come to finance the German sugar crop, even if it be a modest one, as it promises to remain under the present and immediate future circumstances.

According to a statement in the Times, Mr. HUGHES, the Australian Prime Minister, has announced in the Commonwealth House of Representatives that the wholesale price of sugar is now fixed at £49 per ton and the retail price at 6d. per lb. (£56 per ton). If these figures are correctly reported, then the sugar producing interests in Australia would appear to have secured a very substantial concession in answer to their agitation for increased returns to cover the greatly enhanced cost of production.

The per capita distribution of sugar in Canada during 1919 was no less than 94·95 lbs., Ontario coming first amongst the provinces with 130·81 lbs , while Prince Edward Island was lowest with 40·42 lbs. Ontario, Manitoba and New Brunswick use large quantities of sugar for the manufacture of candies and soft drinks.

According to estimates of the Argentine Bureau of Rural Economy and Statistics, the production of sugar in Argentina during 1919 is put at 260,000 metric tons of which 215,000 were produced in Tucumân, 35,000 in Jujuy, and the remainder in the provinces of Salta and Corrienties and the Chaco Territory. Domestic consumption is estimated as 59·4 lbs. per head. Deducting the requirements for consumption, the excess production is placed at about 52,000 tons.

Agricultural Notes.

Cane arrowing and the raising of seedlings.—The laws governing the flowering of the sugar cane are by no means fully worked out, but a good many observations have, from time to time, been made and we are, it is hoped, beginning to see light. The Cane-breeding Station at Coimbatore in South India is peculiarly dependent on the control of this part of the growth of the sugar cane and it has been very closely studied there. Although it is probable that the subject may have to be examined in each place separately, it is thought that the experience gained may be of use where less concentrated attention can be paid to it. A great deal could be written with regard to the various steps in the enquiry, but we must be content here with the barest outlines, leaving fuller details to an article in another number of this journal.

Flowering of the cane has been proved to vary in India with the latitude, even in the same varieties; the annual rainfall and its distribution have a marked influence; the kind of soil and its treatment also cause it to vary, while the different kinds of cane flower at diffierent times and have very different flowering capacity. Individual cane varieties or whole groups of canes do not flower, or merely make the first preparations for so doing; others go so far as to protude unhealthy or malformed arrows with never a fertile flower on them; others, again, make a fine show of fine plumy arrows in great abundance, but these turn out to be sterile, either completely so or in the male or female portions of the flower only; some produce great masses of seedlings which have little vitality and, after a brief period of vigorous growth, die away in thousands; many, lastly, can be relied on to yield a good crop of seedlings which can be guaranteed to grow to maturity. As a result of a series of observations and experiments, it has been found possible in the Coimbatore farm to exercise a certain amount of control on the arrowing of the canes grown there and, within the somewhat narrow limits of the arrowing season, to slightly alter the protrusion of the inflorescences of individual varieties and thus cause them to synchronize with those of others with which it is desired to cross them.

As a result of the study of these phenomena during the past eight or nine years, it is possible to form a fairly accurate judgment of the probable fertility of any arrow which may be received, both as to its male and female organs, and a statement could be made as to the likelihood of the plant from which it had been cut being useful or not in the production of seedlings. It could also be stated what chance there would be of using the arrows of such a plant in the successful crossing work which has now become the routine practice of the station. If the parent or parents are known, it would be possible to forecast the average sucrose content of the seedlings, whether the arrow had been self-fertilized or crossed, and a general statement could usually be added as to the average vitality of the seedlings and their susceptibility to any of the prevailing diseases.

These claims may appear to be somewhat extravagant, considering the somewhat pessimistic notices which have, from time to time, been issued by workers in this field of enquiry. But it is only fair to note that most of these workers have been officers otherwise very fully employed. It is somewhat unfortunate that, while whole time plant-breeding experts have been considered necessary for other crops, the raising of sugar cane seedlings has been considered so easy that it can be done by anyone. But, while that is in the main true, it does not mean that their study is not worth a certain amount of concentration, much more indeed than can be given them by general officers. The success obtained at Coimbatore has been mainly due to the presence of a special problem of some complexity, and a note will shortly be issued dealing with the nature of this problem and the various steps which have been taken towards its solution.

C. A. B.

The Growth of the Sugar Cane.[1]

By C. A. BARBER, C.I.E., Sc.D., F.L.S.

V.

It is well known that different varieties of sugar cane ripen at different times even when planted together, and this has recently become an important factor in milling, as by a careful combination of varieties the season during which matured canes can be obtained is lengthened. Some interesting work has been done on this subject by SOMERS TAYLOR[2] with the canes growing in the Bihar sugar tracts of North India. He had as material local canes belonging to the earliest and latest in India, namely varieties of the Saretha and Mungo groups. He found that, when planted at the same time, good sweet juice was obtained from Khari as early as in December, whereas in several members of the Mungo group the canes were quite unripe at that date. These latter varieties could only be harvested profitably in March, while the best time to cut Khari was during January and February. The same kind of thing is known in many thick canes, but our knowledge is far from complete, and it is highly desirable that more accurate information should be recorded than the casual observations at present available.

But even with a certain amount of knowledge as to the period at which a cane may be expected to mature, it has often been found difficult to tell exactly when it is best to cut it. This is because the multitude of canes brought into the mill vary a great deal among themselves, some being just ripe, and others over or under matured as far as the richness of the juice is concerned. This variation in canes of the same kind we may readily imagine to be due to the fact that the canes of a bunch are not of equal age, as we have seen in our last paper.[3] The canes developed in succession, the *a*'s, *b*'s, *c*'s, etc., ripen one after another, and it becomes of some importance to know the true formula of a particular kind, in order to see which of these orders of branches is present in the greatest number. If the *b*'s are the most numerous, then it will be advisable to cut the canes after the *a*'s have somewhat passed their maturity, and if the *c*'s are present in larger numbers, then it would be advisable to concentrate on their ripening period, and so on. But it is unsafe to judge entirely by numbers, for, as we shall see, the canes of different orders of branching differ very markedly in their weight, their total length and the length and thickness of their joints, and also in the rapidity with which they mature. These differences in appearance will, however, be of use if we wish, at the mill, to pick out the branches of different ages and submit them to a more detailed chemical study.

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[1] The previous articles of this series appeared in our issues of Oct., Nov., Dec., 1919, and Feb., 1920.

[2] See WOODHOUSE, BASU & TAYLOR. The distinguishing characters of sugar cane cultivated at Sabour. Memoirs of the Department of Agriculture in India, Botanical Series, Vol. VII., No. 2, April, 1915.

[3] *I.S.J.*, 1920, 76-80.

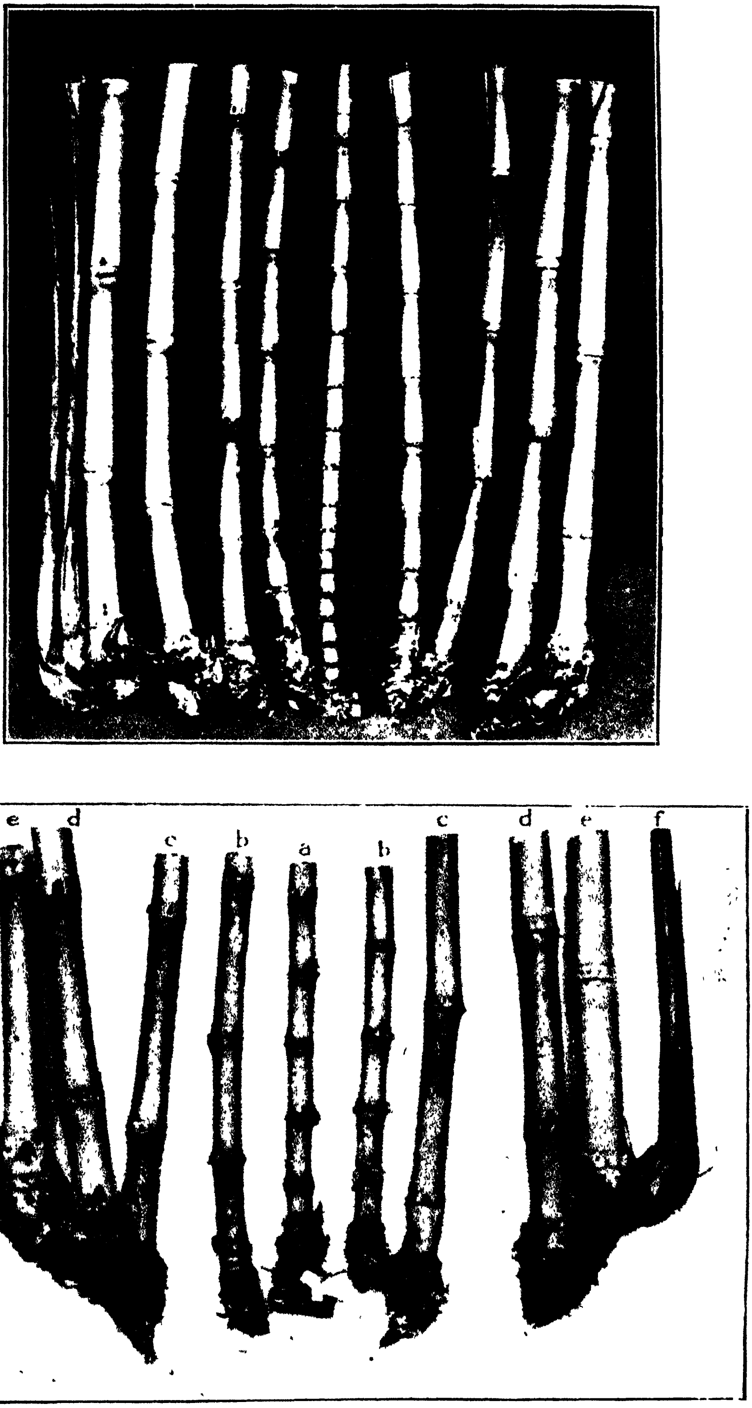

PLATE I.—Branches of different orders in the dissection of *Saccharum arundinaceum*. The main stem *a* is in the centre, and the *b*'s, *c*'s, *d*'s, *e*'s, and *f*'s are arranged on each side, passing outwards from the middle. The characters of these branches are as in Plate II.

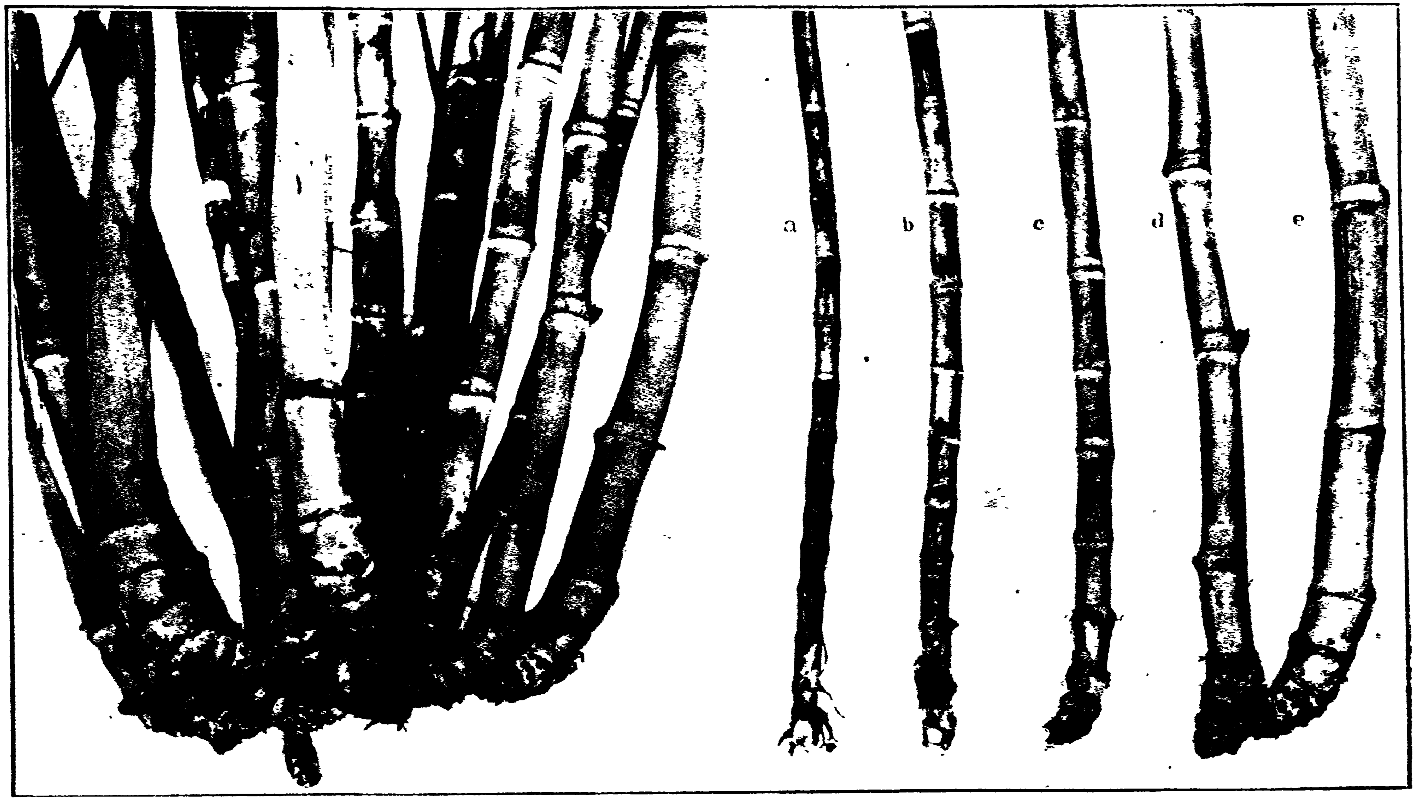

PLATE II.—A dissected plant of Pansahi, nine months old, with typical branches of different orders spread out There is a progressive increase in the length and thickness of the joints and the curvature of the canes, while rooting on the joints becomes less evident The main stem has a white piece of paper around it

In the first place let us consider the rate of maturing of the cane plant as a whole. It can be seen by anyone passing along the rows of canes growing in a trial plot that some, at three or four months of age, are habitually more forward than others in forming cane. It is usual to judge of this by the first formation of naked joints near the ground which have the normal thickness of the variety; but this is rendered difficult in some kinds by the close envelopment of leaves, which sometimes remain attached during the whole life of the plant. This is the case with most Indian varieties and, to make accurate comparisons, it is desirable to take out and clean the plants and make dissections to show their branching systems. During 1916 to 1918 some 350 plants were thus dissected at the cane-breeding station at Coimbatore, when from three to four months old. As the formation of canes is extremely rapid at this period and the dissection took a very appreciable time, the subsequent comparison became extremely difficult. It is not proposed here to mention in detail these and other difficulties which were met with, nor the means adopted to overcome them, but merely to give in general terms the result of the study. This will be seen from the following statement, in which the various groups are placed in order of development :—

Early maturing : Saretha (brown), Nargori, Pansahi, Saretha (as a whole), Sunnabile (Dhaulu section), Mungo (only Kharwi) ;

Moderately early : Saretha (green section), *Saccharum spontaneum*, thick tropical canes ;

Late maturing : Sunnabile (as a whole), Mungo (as a whole), Mungo (without Dhaulu section), Sunnabile (Dhor section).

It is extremely desirable that similar lists, founded on careful observations, should be compiled of the rate of cane formation in comparative varietal plots. The kinds that really matter in such plots are generally few in number, and the work could be done each year in a much shorter time than that done at Coimbatore, thus ruling out the difficulties which were met with there.

The study of the differences between the branches of different orders, namely the *a*'s, *b*'s, *c*'s, etc., was also a difficult piece of work. It had long been felt that such a study was needed, because of the occasional observation, especially in certain varieties, of those thick, late-formed shoots, called "gourmandizers," which usually had little sugar in them at crop time. But a final decision was arrived at, when it was found out that the canes in each bunch were not uniform and in fact differed so much among themselves, that the current method of sampling a plot of canes was likely to introduce serious errors. Thus, when picking out 20 canes at random for measuring, it was easy, in certain varieties, to separate them into different classes which on examination turned out to be of early and late formation. The former were longer and thinner, had more and shorter joints, and had apparently richer juice. In our study of seedling canes these differences among the canes of different ages in the same plant were found to be much more pronounced. The colour often varied with the age from green or yellow to grey or even purple, the thickness was sometimes three times as great in the later canes and the proportion of rooting and general habit differed quite as much. It soon became necessary to lay down rules as to which canes in the bunch should be selected as typical of the seedling, both as to its external form and the richness of its juice. When, therefore, the dissection work was taken up on a large scale, a series of measurements of each and every cane was introduced, from which to learn something of the meaning as well as the persistence of these differences. The results have fully justified the enormous amount of labour involved.

In the plants of *Saccharum arundinaceum* and Pansahi shown on the Plates[1] some of these differences are very clearly shown; it is at once obvious that the *a*'s, *b*'s, *c*'s, etc., vary greatly in certain characters. Among the characters chosen for special study were the rate of cane-formation, the thickness and length of the canes, the shape of the cane, and the amount of curvature of the base, the amount of rooting and shooting, the richness of the juice, and so on. Averages have been struck in all the canes of the same order of branching, in each plant, clump, variety and group, as well as the whole series dissected, and some of the results are given briefly below.

(1) *Rate of early development.*—Included in this term is the period between the shooting of the bud and the completion of the thickening of the cane, after which it proceeds to add joint to joint as the leafy shoot is thrust into the air The region concerned consists of short, disc-like, superposed joints which gradually become thicker and longer, and, after some study, it was decided to limit it upwards by the first joint which had reached one inch in length. After this the thickness did not appear to vary much and the joints quickly assumed their usual length. The length of this basal, preparatory portion of the cane was carefully measured in each and every cane of the hundreds of plants dissected, and the results were tabulated and averaged. It was found that the *a*'s, that is the main shoots, were much the slowest in development. This is indeed not to be wondered at, when we consider the quantity of roots and leaves at the disposal of the plant at this period. The main branches (*b*'s), on the other hand, starting from a ready formed cane with larger equipment of root and leaf, went through their preparatory period much more rapidly, and this rate of development was seen to increase in subsequent orders of branching. But the matter soon became complicated by the fact that the later branches had to place themselves further from the centre of the plant for free growth, thus introducing a curvature at the base which is not seen in the *a*'s or generally the *b*'s. This curving region increases with the order of branching and mere measurements of the length of the basal portion were insufficient to demonstrate the rate of development. This fact must be taken into consideration in the figures that follow. The average length of the basal portion in all the *a*'s and *b*'s measured was 3·7 and 2·6 inches respectively. Taking only the Saretha and Pansahi groups of Indian canes and the six thick tropical canes, we have the following averages (in inches):—

	a	*b*	*c*	*d*	*e*
Saretha group:	3·4	1·7	2·0	2·4	(2·0)
Pansahi group:	3·1	2.0	2·1	2·5	2·3
Thick canes:	2·8	2·4	2·8	(3·8)	

the figures in brackets being founded on an insufficient number of measurements for accurate determination.

(2) *Average length and thickness of the mature joints.*—The measurements in joint length were commenced after the basal part had been passed, that is, after joints one inch in length had been reached; the thickness was taken of the cane at two feet from the base. The differences in these respects of the branches of different orders are very well seen in the Plates, and it is merely necessary here to record the averages of the actual measurements taken. As has already been stated, the observation of such phenomena has always been found much easier in the Pansahi group of canes and in the wild *Saccharum arundinaceum*, and these have been selected for reproduction, because they show the differences

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[1] The illustrations to this article have been taken from a paper by the author which was originally published in India· they are here reproduced by kind permission of the Agricultural Adviser to the Government of India.

so well. Averages are also added for the Saretha group and for the six thick cane varieties dissected. There is much more variation in these, and no individuals if figured would be likely to present the matter in so striking a manner; but by the averaging of a very large number of measurements in each (usually many thousands), these irregularities have been ruled out and they fall well enough into line:—

AVERAGE LENGTH OF MATURED JOINTS ABOVE THE BASAL PART, IN INCHES.

	a	*b*	*c*	*d*
Saretha group:	2·2	2·8	3·3	4·5
Pansahi group:	2·1	2·8	3·3	3·6
Thick canes:	1·8	2·4	2·8	3·0

AVERAGE THICKNESS OF CANE AT TWO FEET FROM THE BASE, IN CM.

	a	*b*	*c*	*d*	*e*
Saretha group:	1·59	1.66	1·78	1·92	2·04
Pansahi group:	1·66	1·66	1·86	2·23	2·84
Thick canes:	2·63	2·82	2·90	3·45	

(3) *Richness of juice in branches of different ages.*—This has been the subject of repeated study in the Pansahi group of canes, where the cut canes can be so readily divided into early (*a*'s and *b*'s) and late (*c*'s and *d*'s), and the results are very interesting. Two sets of analyses are given, which were made in 1916-17 and in 1917-18.

SUCROSE IN THE JUICE OF MEMBERS OF THE PANSAHI GROUP.

			Per cent.		Per cent.
1916-17.—	*Maneria* (one clump):	early canes	11·30	late canes	9·52
	Ditto (whole row):		10·29		7·24
	Yuba (6 canes each from one clump):		10·61		7·94

			Per cent.		Per cent.		Per cent
1917-18 —	*Maneria*:	very early canes	16 90	early	16·40 to 16·48	late	13·99
	Yuba:	,, ,, ,,	17·81	,,	17·17 to 17·77	,,	16·13

From these examples we see that, in the samples taken, the earlier or older the canes the richer the juice, and it would be interesting to compare these results with analyses taken at other places, especially as the sucrose content of the members of the Pansahi group appear to have so much richer juice in other tropical countries than in India. Thus far we have failed to establish similar relations of the juice richness in other groups of canes, possibly because of the fewness of the observations and the irregularities in such groups.

From these and other facts elicited regarding the character of the juice in canes of different ages and in the different joints of a cane during its growth, we have been led to a certain conception as to what goes on in the ripening cane, as of influence on the behaviour at the mill, and it may be of interest to place it on record. The cane plant commences in a small way and, at first, is only capable of small things. But, as it gets bigger, has more roots which penetrate deeper into the soil and has larger and more numerous leaves wherewith to obtain food from the atmosphere, its capacity increases and greater numbers of thicker canes are produced. Each cane, as it reaches its appropriate thickness, proceeds to grow in length, but its joints, being at first young and tender, are filled with sap devoted to the building up of fresh tissue. But as the tuft of leaves is pushed into the air by the formation of new joints, one for each leaf, the older joints become less intimately connected with tissue formation. They become more mature and their large central cells become inert and charged with cane sugar, while the more actively living tissues are limited to a narrow external band, whose main function is the transmission of food from the roots to the shoot.

When all but the uppermost joints reach this later stage, the cane is said to be mature and is ready for cutting. It does not seem likely that anyone will quarrel with this conception of the sequence of events.

We have seen that the canes of a bunch arise in succession, first the mother shoots from the buds on the set, then the branches of the first order and, later, those of the second, third and other orders, according to the system of branching as determined by the formula. A study of the dissections shows that there is usually a considerable period between the appearance of the first and last canes of each plant. In all of these the same sequence of changes may be assumed to take place in the contents of the joints, and thus there will be considerable differences in the times at which the different canes arrive at maturity and are fit for the mill. We have some reason then to suppose that the canes at crop time will not be equally matured, unless indeed no further change take place in the canes after they have reached maturity. But there are abundant signs that such a change does take place, although it appears to differ in extent and rapidity under special local conditions and in different kinds of cane. There are in fact evidences that, after a cane has matured, if left uncut, a process of deterioration sets in, the main result of which is that the purity of the juice and the quantity of sucrose in it decreases. The causes which induce this change in the stored sucrose in the large cells of the joints need not concern us here. The following analyses will illustrate our point. They were made at the same time as those of *Maneria* and *Yuba* quoted above in 1917-18. It was, at the time, recorded that the tops of these canes had withered because of drought, but the analyses were made just the same to see what the effect of this premature maturing would have on the juice.

SUCROSE IN THE JUICE.

		Per cent.			Per cent.			Per cent
1917-18.—Pansahi:	Very early canes	13·58	..	early	15·88 to 16·28	..	late	13·66
Suda Khajee:	,,	15·82	..	,,	16·58 to 17·84			

From these facts we learn that in each cane there will be a gradual rise in the quantity of sugar in it until an optimum is reached, after which there will probably be a more rapid decline in its content of this substance. If we take a milling period of one hundred days and assume that but one kind of cane is grown, all of it planted at the same time, we should in practice be most of the time cutting many canes which are not by any means at their optimum as regards sugar content. We should commence with the cutting when the mother canes are ripe, but their branches would be increasingly unripe the higher the order of branching and the later they had risen in the bunch. Then, when the mother canes were a little past their prime, the *b*'s would be at their optimum, but the *c*'s and *d*'s would still be unripe; lastly, when the latter canes became fit for the mill the mother canes would be much deteriorated and the *b*'s would also have passed their optimum of sugar content.

The best time to reap a crop will be when the greatest weight of canes is mature; this will depend on the formula, and will, for instance be very different for Yuba and B.208, and probably for Red Mauritius as compared with either. The formulae tend to be symmetrical on each side of a certain order of branching, and if the system is small, there will be most *b*'s, if large most *c*'s; but it is to be remembered that not only the number but the individual weight of the canes has to be considered, and this is invariably greater in the *c*'s than the *b*'s. It will be seen that there is plenty of scope for study in this matter, and it would be well, in the selection of early and late maturing canes, which will be necessary to extend the milling season to as great a length as possible, also to consider the optimum ripening of the canes of different orders of branching. With the marked differences to be observed between the early and late canes as detailed above, it should be possible with a little care to separate them at the mill, and it is suggested that an occasional analysis of the canes of different ages and stages in ripeness may be of use in getting the greatest amount of sugar out of the crop.

The Technical Training of Sugar Factory Chemists in Queensland.

The training of sugar chemists in Queensland started about the time of the introduction of the Sugar Cane Prices Acts of 1915 to 1917 (i.e., in the year 1916). Section CA (1) of the Amendment Act of 1917 states that any person desirous of being appointed as a check chemist shall first satisfy the Check Chemist Examining Board appointed by the Minister for that purpose that he possesses the necessary qualifications, whereupon the Board shall issue a certificate certifying to the same. And the possession of such certificate shall be held to be sufficient evidence that the holder has the necessary qualifications for the discharge of his duties as check chemist, and may be appointed by the Minister (the Secretary for Agriculture and Stock or other Minister of the Crown charged with administration of the Act) to any sugar mill where, in the opinion of the Minister, the services of a check chemist are desirable.

At this time there was a scarcity of sugar chemists, and it was found that greater facilities for training would have to be provided. So in 1916 it was decided to establish, in connexion with the Department of Public Instruction at the Brisbane and Bundaberg Technical Colleges, classes so arranged as to qualify candidates to conduct the chemical control of any sugar factory, embracing the determination of the value of sugar cane; sugars and factory products; checking of waste; chemical bookkeeping; control of chemical manufacture; manuring, cultivating, and irrigating cane; analysis of soils, waters and manures (including phosphate rocks, limestones, etc.).

The courses consist of lectures and laboratory work extending over three years; and they are divided into three stages, viz.: Junior assistant; assistant; and sugar chemist. Subjects to be taken concurrently are: Algebra; arithmetic; mensuration; inorganic chemistry, and physics. Visits to cane fields, sugar mills and refineries are arranged for the students, when the district affords facilities for such.

The syllabus is as follows:—

Junior assistant sugar chemist.—Definition of terms used in industry; general outline of manufacture and objects of chemical control: use of balances; metric weights, etc.; preparation of standard acid and alkali solutions; determination of acidity and alkalinity and use of indicators; preparation and standardization of Fehling's solution; determination of sp. gr. by hydrometer, etc.; use of the refractometer; elementary theory and use of the polariscope; determination of sucrose in sugars, juices, syrups, and molasses; volumetric determination of glucose; methods of sampling cane in field and mill for the determination of fibre, sucrose, Brix, glucose and ash; calculation of "commercial cane sugar" in cane; also methods of sampling and preserving juice in the mill.

Assistant sugar chemist.—A short review dealing with the principal cane varieties, their structure and composition; their suitability for various localities;

and value for milling purposes. Change of composition due to burning, frost, diseases; and the deterioration of cane after cutting. Clerget's method. Study of the principal operations of manufacture and essential machinery. Chemistry of manufacture; extraction; clarification; subsidence; evaporation; boiling; drying; etc. Chemistry of principal sugars, and methods of estimation and separation. Analysis of by-products and raw materials, such as lime, clarifying agents, etc. Sugar-house calculations and chemical bookkeeping.

Sugar chemist.—Sugar cane cultivation. Manuring experiments. Irrigation. Calculation of efficiency of various units. Sources and determination of losses. Theories of sugar-boiling and exhaustion of syrups. Analysis of waters for irrigation and boiler feeds, also of soils and manures.

The above training of sugar chemists in Queensland is certainly good as far as it goes; but the general concensus of opinion in the Colony is that it does not go far enough. Theoretical knowledge in itself is mere prattle without practice, and if those interested in the future welfare of the industry, the Government, planters and millers, would combine to erect as complete a sugar factory in miniature as possible, with effects, vacuum pans. crystallizers, centrifugals, filter-presses, etc., large enough to yield practical information, and under the direction of a first class instructor, students could be trained in a thoroughly *practical* as well as a theoretical manner.

Evidence enough was given before the recent Royal Commission of enquiry into the sugar industry to warrant a school of this nature. The application of scientific chemical control of the sugar industry has manifested itself under the system of cane price fixing, where a factory must attain a 90 per cent. coefficient of work, making 94 net titre sugar as the standard, before any profits are made. And the results are sufficient proof that the old system of acquiring some practical experience with insufficient theoretical knowledge is very unsatisfactory.

The Williams shredder has been discarded in certain factories in Hawaii, on accoun of litigation in connexion with patent infringement.

Central El Pilar, Artemisa, Cuba, produced 128,050 bags of sugar last year, but the estimate for the present crop is given as 240,000 bags.

Seven new centrals are in course of erection on the island of Negros, Philippine Islands. Isabella just completed to the design of Catton, Neill & Co., Honolulu, is the first to get to work. Its equipment includes a 15-roller mill and crusher, Ramsay conveyors, Howe juice scales, 3 filter-presses, a triple and two 9 ft. vacuum pans, and Cresson-Morris belt driven centrifugals.

Mr. W. P. NAQUIN Manager of the Pacific Sugar Mill and Honokaa Sugar Co., T.H. reports that he has had an Ogg-Haldén cane knife apparatus in use for one season, and that in grinding about 130,000 tons of cane only four of the knives were broken. It consists of a 15½ in. c.i. roller serving as the hub, the remaining space in the slots being filled with babbit or lead. In the first set, as a precaution, screw bolts are passed through the hub and knives, parallel to the shaft.

An Empire Development Parliamentary Committee has been in existence for a few months, to which about 200 members of the House of Commons are said to have given their support. The objects of this committee are, generally, to support the Secretary of the Colonies in the execution of his policy to further the development of the Empire. It is moreover desired to urge upon the Government and Parliament that sugar (*inter alia*) can by Empire development be increased in quantity and reduced in price, while its cultivation will assist in correctin adverse rates of exchange.

Notes on American Sugar Production.

By our American Correspondent.

The course of the raw sugar market thus far during the present season has demonstrated very strikingly the exceptionally strong position which the Cuban sugar producers occupy. Ordinarily, at this period of the year, with the grinding campaign at its height, Cuban centrifugals are being pressed upon this market in heavy volume and buyers are able to force substantial concessions in prices. Up to the present writing we have had continuously a sellers' market this year and the trade is beginning to question whether this condition may not prevail throughout the season.

On two occasions cable delays in forwarding advices of shipments from Porto Rico and Cuba caused several unsold cargoes to arrive here simultaneously and in those cases a temporary decline in prices occurred. In each instance, however, the recovery was prompt and vigorous. Whenever signs of a general buying movement appear prices advance and whenever quotations weaken holders withdraw from the market.

There is no question that the profits of the past few years have put the Cuban sugar producers in a far more independent position than they ever before occupied. Where once their crops were mortgaged before they were grown many of the planters are now in a position to command credit on terms as favourable as are extended to other business men. Undoubtedly too the Cubans have come to realize that their former sales policy meant the sacrifice of many millions of dollars yearly. Last month, when the price of 96° test centrifugals fell temporally a cent a lb., the recently organized Association of hacendados and colonos promptly recommended that Cuban colonos release the mill owners temporarily from the payment of more than fifty per cent. of the amounts due them in settlement for cane delivered. Such action, it was estimated, would relieve the operators of the mills from the necessity of forcing their sugars upon a declining market. The colonos quickly adopted the suggestion, and many of them voluntarily agreed to accept payment for their cane on a basis lower than the official promedios of the college of brokers.

This manifestation of a new spirit in the relationship between mill owners and cane growers in Cuba indicates the extreme unlikelihood of a return to the old system of selling the entire crop such as has been proposed at various times.

The Porto Rican producers are likewise considering the organization of a co-operative sales company to dispose of their crop, modelled on the Sugar Factors Company, Ltd., of Hawaii. They also have suggested to the Cubans the adoption of a plan by which only one-tenth of their respective crops shall be forwarded to this market in any one month. By spreading shipments over a period of ten months, they hope to avoid pressure of heavy supplies of raws during the height of the campaign and the consequent depression of prices.

The purpose of all these plans, most of which are yet in a tentative stage, is to enable the producers to obtain a fair share of the average prices that prevail in the raw sugar market during the year. With the number of potential buyers limited to a half dozen refiners the smaller producers have been at a decided disadvantage in the past in selling their output. Now that they have achieved a degree of financial independence, more attention undoubtedly will be paid to problems of marketing, with the possibility of the ultimate organization of banks and co-operative warehouses to aid in carrying sugars over periods of temporary depression.

While the producers of raw sugars are thus planning to extend the degree of their control of their products, the refiners on their part are reaching out to become producers instead of mere middlemen in the work of preparing sugar for market. The action of the American Sugar Refining Company in purchasing Central Cunagua was the first step in a plan which has long been under consideration for the acquisition of plantations and centrifugal mills. It is the policy of the company to develop an organization that will handle sugar at every step from the growing of cane to the delivery of the finished product into the hands of retail sellers.

Within the past few weeks the Warner Sugar Refining Company has acquired Centrals Gomez Mena and Amistad in addition to the two Cuban properties previously owned by interests associated with this company. Mr. C. A. SPRECKELS, controlling factor in the Federal Refining Company, has long had extensive interests in Cuban properties. The management of the National Sugar Refining Company are actively identified with large Cuban producing companies and the Pennsylvania Refining Company is now undertaking the production of sugar on a large scale in Florida. Thus the tendency of refiners to participate in the growing and milling of cane has developed to the point where it may be accepted as a definite policy.

It is obvious that these two lines of development, in the course of time, may alter very decidedly the organization of the sugar industry in the United States and Cuba. If the refiners turn to the production of a considerable part of the sugar handled in their refineries the raw sugar producers may find it necessary, or at least advantageous, to turn out a finished product that can directly enter the channels of distribution and consumption. In fact a very noticeable movement in this direction already is well under way and will be discussed in some detail in a future letter.

From the time when the beet sugar industry was first established in the United States the various companies engaged in this industry have followed the policy of turning out from their factories white sugars ready to go directly upon the table. In this way they have diverged from the usual practice of European producers of beet sugar, the majority of whom have restricted themselves to the output of raw sugars which were passed through regulation bone char refineries on their way to the consumer. Now a policy of self-sufficiency similiar to that practiced by the American Beet Sugar Producers seems in a fair way to be adopted in the cane industry. If the various plans being worked out to achieve this result prove successful, it will have a decidedly broading effect upon the sugar market and undoubtedly will be to the interest of the consumer, who will have a much larger number of separate interests competing for his favour.

New York, March 17th, 1920.

In Paraguay sugar cane grows well in the northern and eastern cordilleras and a part of the Chaco, but at present the area planted with cane is limited to some 7750 acres. The gross weight of cane grown during 1918 was 387,500 metric tons, while 1919 crop is estimated at about 400,000 tons. During 1918 the Paraguay refineries produced 562 metric tons of sugar, 180,121 litres of rum, 51,500 litres of industrial alcohol, and 325,900 litres of rectified alcohol. The production was not sufficient for the consumption, so 2,300 tons of sugar were imported.

Report on Progress made in Sugar Manufacture and Utilization of By-Products in Hawaii.[1]

By W. v. H. DUKER, W. P. NAQUIN, and S. S. PECK.

Milling. Clarification. Filtration. Boiling. Bagasse Utilization for Mulching Paper. Molasses Utilization for Motor Fuel ("Natalite").

Milling.—At the time of writing this report, the final figures of all the plantations were not available, but from the weekly mill return issued by the Experiment Station, it was at once apparent that another record had been made.[2] The average extraction is again higher than in any previous year, and two of the leading mills regularly report values over 99 per cent. Comparing the results of Java factories with those obtained in Hawaii for the year 1918, the following figures are found:

	HAWAII.	JAVA.
Crusher and 12-roller mill	97·1	93·4
Crusher and 9-roller mill	96·0	90·8

Although a certain equipment is essential, it has been demonstrated again this year that the results depend very largely upon the skill and ambition of the operators. Arguments concerning the economical limit of extraction[3] are being abandoned, since it is noticeable that those factories obtaining the highest extraction figures are also those first succeeding in reducing the loss of sugar in the waste molasses. Gravity purity values for final molasses of 35 and 36° are reported week after week. The most necessary means of reaching such a high standard in milling are the use of shredders, juice grooves, and knives, together with the use of additional units, *e.g.*, up to 15-roller mills. Given such a milling plant, the essential points in operating it are the evenness of feed throughout the entire train, the use of high pressures, and the securing of a high extraction with the units preceding the application of the maceration with diluted juice or water. It is to be remarked that no proper device has been discovered that is capable of accomplishing the complete admixture of the maceration water and the bagasse. In fact, it is doubtful whether the full benefit of maceration can be expected unless the bagasse is submitted to a complete maceration for a certain time. This would not be far from the diffusion process.[4]

Dr. NORRIS has published figures showing that as a rule there exists quite a difference between the density of the juice running from the first roller and that coming from the back roller of the mill.[5] This would show that the maceration water had not had time to penetrate the bagasse, much of the water being expressed again without having had any practical effect.

Mr. F. F. BALDWIN, manager, Hawaiian Commercial & Sugar Co., wrote that he had been reducing his rate of grinding from 120 to 95 or 100 tons of cane per hour, while raising the maceration from 35 or 40 per cent. to about 50 per cent. These changes had resulted in reaching an extraction of almost 99 per cent., an increase of 0·5 per cent. compared with the last two years, which establishes a record for 12-roller mills. He intends to operate a 15-roller mill next crop by using the 4th mill of the B train in conjunction with the full A train and putting in cross conveyors. This will result in a considerable saving in labour and power. All but two of the crew of the B train can be dispensed with, and it will not be necessary to operate the following plant of the B train: main engine; crusher engine; carrier engine; shredder motor; two leveller motors; unloader motor; cane winch; main juice pump, and several small juice pumps, a total saving of 11 men per shift and of 850-1000 I.H.P. It is expected that the additional mill will make up in extraction for the higher tonnage and speed of running.

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[1] Summary of a Report presented to the Hawaiian Sugar Planters' Association.

[2] See *I.S.J.*, 1919, 563. [3] *I.S.J.*, 1919, 17. [4] *I.S.J.*, 1919, 563. [5] *I.S.J.*, 1919, 465.

Mr. H. S. WALKER, superintendent, Pioneer Mill Co., reported that for the 1920 crop his installation will consist of a crusher, shredder, and a 15-roller mill having a uniform width of 72 in. from the cane carrier onwards. All the mill hydraulics will be placed on top. All 3-rollers of the first mill will be deep grooved, ¾ in. pitch, and 35° points; the feed rollers of the 2nd, 3rd, 4th and 5th mills will also be deep grooved; but the top and discharge rollers will remain as before, viz., 7 grooves to the inch. On deep-grooving the feed roller of the last mill towards the end of the 1919 crop, a great improvement in feeding was found, while the moisture in the bagasse dropped by about 2 per cent.

Clarification.—Mr. WM. W. GOODALE, manager, Waialua Agricultural Co., wrote that he has been making efforts to improve the colour of the sugars made in his factory, which are said to be darker than the average. Dark rind varieties as Demerara 1135 and Rose Bamboo canes are ground, the result being that the juice is darker than in other mills. He found no trouble in obtaining a good clarifying effect on liming heavily and removing the excess of lime by means of phosphoric acid.

Filtration.—In Hawaii the ordinary plate-and-frame press is still universally used, and apparently has held its own against other devices, as the Oliver, Sweetland, and Kelly filters, though the latter is being used successfully in Java. A few mills filter the subsided juice through excelsior or bagasse, and most use fine copper screens.

Boiling.—Mr. WM. LOUGHER, mill superintendent at Puunene, stated that he had changed from a three-boiling system to a two.[1] First strikes are started on a magma of syrup and No. 2 sugar; built up with syrup; cut; built up again with syrup; and finished either with remelted sugar or No. 1 molasses, a massecuite of 76 to 87° purity yielding molasses of about 54 to 57° purity thus being obtained. No. 1 molasses is boiled to grain; built up with more No. 1 molasses; cut, either once or twice; and finished either with No. 1 molasses, or with remelted sugar, this massecuite going to the crystallizers for as long as possible, say 7 to 10 days, and thinned up with about 10 per cent. of dilute waste molasses during the last 24 hours it is there. This addition has a marked effect on "drying."

Mr. E. CROPP, manager, Koloa Sugar Co., mentioned that he had boiled a molasses of 37° apparent purity to string proof, and charged it with sugar dust shortly before dropping the strike with results promising enough for further trials in this direction.[2]

In reference to the difficulty which has been experienced in curing low-grade products,[3] it now seems clear that the cause is the fine false grain forming either in the pan or later in the crystallizers and tanks. Mr. W. McALLEP has made a report on the question in which he says that, while more efficient means of separating high density molasses from the crystals is desirable, most factories could reduce the purity of their final molasses below the present average figure by improving the grain of their low-grade massecuites. Slow boiling is an important condition in securing this. An even grain should be formed, and the massecuite concentrated slowly to a high density, taking as long as 12 hours or more for the strike, the formation of false grain being carefully avoided, and the purity of the mother-liquor reduced as low as possible before dropping to the crystallizers. The use of a small grain is a second condition. For a certain weight of sugar separating out it gives more crystal surface in the massecuite than a large one, which is favourable for crystallization. Measurements made by Mr. McAllep indicate that 0·2 to 0·3 mm. is a desirable size for the crystals, and this is about as small a grain as can be handled successfully in the centrifugals. It is true that a larger grain would facilitate centrifugal work, provided false grain can be avoided; but in all cases observed when the grain was large and the massecuite was concentrated to a high density, false grain had formed, either in the pan or in the crystallizers, or in both. These observations relate to factories having crystallizer equipment. In the case of massecuites resulting from blank boiling, which are crystallized in storage tanks, it was found that the grain was extremely uneven. Usually in the last boiling, the crystals are of almost triangular section, a shape which appears to "pack" in the centrifugals, leaving only the smallest interstices for the flow of molasses.

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[1] *I.S.J.*, 1919, 88. [2] *I.S.J.*, 1919, 36 [3] *I.S.J.*, 1919, 133.

Mr. John A. Scott, manager, Hilo Sugar Co., reported that at the end of 1917 his factory was boiling a No. 2 massecuite of 94° Brix, and disposing of a final molasses of 39·25° gravity purity, in which the grain was very numerous and triangular in shape. Blank strikes were noticed to give crystals which at first were square but became triangular when the mass cooled. When these triangular crystals form, the process of exhaustion is slow, and the purity of the resulting final molasses is high. Moreover, massecuite containing crystals of this shape does not seem to "dry" as well in the centrifugals. In order to test the work in the pan, a large grain was boiled slowly, and the gravity purity of the molasses taken as soon as dropped, when it was ready to be dried, and lastly after it has been dried. The following results were obtained, showing that the process of boiling was in order, the mother liquor being exhausted during the operation, but that after passing the machines a high loss of sugar occurred:—

	After dropping	After 7 days in crystallizer and 7 days in tanks	After drying.	Decrease in purity	Loss after drying
Test 1 ..	42·7	33·62	35·95	9·08	2·33
,, 2 ..	43·5	34·7	35·95	8·8	1·25
,, 3 ..	44·5	32·5	36·4	12·3	3·9

In order to find some means of preventing this loss at the machines, the tops and bottoms of the screens were overlapped with filter-press cloth 1 in. on each side. Losses of massecuite over and under the screens were thus avoided to a great extent, although upon examining the grain under a glass, and comparing the size of grain with the size of the holes on a screen having 625 holes to the sq. in., it was found that the diameter of fine crystals was about one third, enabling them readily to pass through. On examination of the molasses, it was further noticed that more grain passed through at the beginning of drying than at the end. Working along these lines, it was found possible to reduce the purity of the final molasses from 39·25 to 34·6°, giving by the *S. J. M.* formula an increased recovery of 1·44 per cent. (92·0 to 93·44 per cent.).

Mr. A. W. Collins, Pioneer Mill Co., said that the method of boiling in use was practically the same as that which had been in operation during the past five or six years. Instead of boiling back low molasses continuously to make a fixed purity massecuite of about 76 to 78° purity, every third strike is made of straight syrup, taking back molasses in the next two until the purity of the molasses is reduced to about 55°, when it is boiled for the crystallizers. This method reduces the amount of molasses in circulation, and, as the average purity of the massecuite boiling is higher, fewer strikes are required to produce the same weight of sugar.

Its disadvantage has been the difficulty in keeping the polarization down to 96°, but this is controlled by "painting" the high testing sugar from the syrup strikes while in the machines with enough molasses of 55° purity to displace the high molasses adhering to the crystals.

Mr. J. E. **Biela**, Kohala Sugar Co., described the method of boiling at his factory. A charge of syrup is boiled in pan 1 to graining point, and second sugar in magma drawn in as seed. Boiling is continued to full capacity of the pan (270 cub. ft.), at which point half is drawn over to pan 2, in which syrup or remelted low-grade sugar has been prepared; boiling is continued with syrup, and the strike finished with first molasses. Pan 1 is boiled to full capacity again, and the whole mass drawn into pan 3, the operation of which is similar to that of pan 2. Pans 2 and 3 (676 and 710 cub. ft. capacity respectively) are cut frequently. First molasses is returned into the strikes so far as is consistent to obtain sugar of 96° polarization and molasses of a sufficiently low purity to warrant reboiling as second massecuite. First massecuites are boiled to about 98° Brix, and have an average purity of 74 to 76°, and they are cured hot. Second massecuites are boiled blank into crystallizers at about 95° Brix, and after 11 days the stirrers are operated twice each day for about an hour each time. Third massecuites are boiled only if the second molasses is of a purity to warrant a fair return, and it is left in storage tanks according to the available capacity.

Utilization of by-products.—Mr. J. P. **Foster**, factory superintendent, Maui Agricultural Co., is utilizing a portion of his waste molasses for the production of motor alcohol ("Natalite") for the operation of trucks, tractors, automobiles, etc.[1] It is produced at the rate of 350 gallons per day, and, not taking into account the molasses, the cost per gallon is about 8 cents. One ton of molasses produces 60 gallons of the spirit. This scheme is a successful one. Another interesting development is that termed "by-product power," mention of which has already been made.[2]

Mr. C. F. **Eckart**, manager, Olaa Sugar Co., Ltd., reported that his paper making plant is now turning out a material of excellent quality for the purpose of mulching[3] and in quantity to meet requirements. Up to October, 1919, the amount of asphalt-saturated paper produced was 11,816 reams, weighing 986 tons, or an average of 166·89 lbs. to the ream. Its average bursting strength is 22·17 lbs. per sq. in. It was obtained from 644 37 tons of "raw" paper, weighing 10·583 lb. per ream, having an average bursting strength of 21·56 lbs. per sq. in. Up to date, 810·8 tons of the asphalt-saturated paper have been applied in the fields, and 1150 acres have been treated by the mulching process. Working 12 hours per day, the plant is capable of supplying sufficient for 3000 acres per year.

Considerable dissatisfaction continues to be evinced in Natal at the Government maintaining the control price for home consumption at the low figure of £28 5s. per ton, while meantime sugar has been sold at Durban for export at £61 10s. per ton f.o.b. It is pointed out that as a matter of fact Natal and not Australia holds the world's record for lowest sugar prices during the war period, and since the Armistice there has been no proportionate improvement in prices.

In a recently published book on the manufacture of chemicals by electrolysis by A. G. **Hale**, a summary is given of some recent work done on the preparation of hydrosulphites by the electrolytic reduction of sodium sulphite. Processes of this kind have been devised *inter alia* by **Spence & Sons**, **Elbs**, and **Jellinek**.

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[1] *I.S.J.*, 1915, 533; 1916, 32; 1919, 519; 1919, 542, 564; 1920, 173.

[2] *I.S.J.*, 1920, 158.

[3] *I.S.J.*, 1918, 567; 1919, 349, 626.

Bagasse Furnaces.[1]

By A. G. BUDGE.

It is in the design of the furnace and its operation that the greatest effective economy can be obtained in the boiler-house. In most factories, therefore, this is a subject of interest, upon which it is necessary to be informed.

The general type of furnace (the Ginaca-Keech[2]) used in factories in Hawaii is shown in figure I. It has been modified by different engineers, influenced by certain conditions of operation, and there are now several installations having the same general characteristics but varying in detail.

In figure II is shown the type of furnace in use at the Hawaiian Commercial & Sugar Company's factory under 7 × 20 ft. return tubular boilers, a design which has given entire satisfaction there. A somewhat similar type has been installed under one of the water-tube boiler plants, but the results do not indicate any radical improvement compared with the previous equipment, due probably to a set of conditions which have not been duplicated.

The first water-tube boilers installed in the Territory were built with furnaces similar to that shown in figure III, but sufficient consideration was not given to the greatly increased boiler heating surface which now has to be served.[3] As the consequence, while these boilers are all doing the work required, they are in no instance giving the overload which might be expected from an installation of this kind, provided sufficient fuel was burned.

Recently the water-tube (Stirling) boiler installations at Onomea, Pepeekeo, and Hakalau were tested in order that a type of furnace more suitable to this boiler might be evolved, and the results are given in the following table. It was shown that none of the boilers was developing rating, although they were carrying the load originally demanded for the factory operation. It is probable that under present conditions rating could not be developed in any of these boilers without having a more effective furnace, that is, a better grate area and combustion space. In other words, the furnaces are too small for the amount of work now required of them, and when an endeavour is made to force the boilers the trash is carried through the setting.

Therefore, for the new installations the furnaces have been designed to burn more fuel. It is believed that the improved type will have a capacity sufficient to develop an overload with the boilers while encountering no difficulty in maintaining efficient combustion at any required load. Both volume and grate area have been more than doubled compared with the earlier type of setting. Now the ratio of the combustion volume to the boiler horse-power is about 2·25 to 1, and the ratio of the grate area to the heating surface is about 1 to 72; whereas previously these ratios were 0·85 to 1 and about 1 to 115 respectively.

In Hawaiian factories the trash available for fuel is drier and much more combustible than that in most other sugar producing countries. As the result of this, it has not been necessary in the Territory to go to expensive and extreme designs, as is the custom for example in Cuba. A typical Cuban bagasse furnace is shown in Figure IV, from which it will be noted that the amount of brickwork is far in excess of that required in the case of installations in Hawaii. Probably,

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[1] Extracted from a Report on "Boiler Room Equipment and Operation" presented to the Hawaiian Sugar Planters' Association.

[2] See U. S. Patents, 791,023, 797,805, and 856,011.

[3] See also an article by A. GARTLEY; *I. S. J.*, 1919, 232.

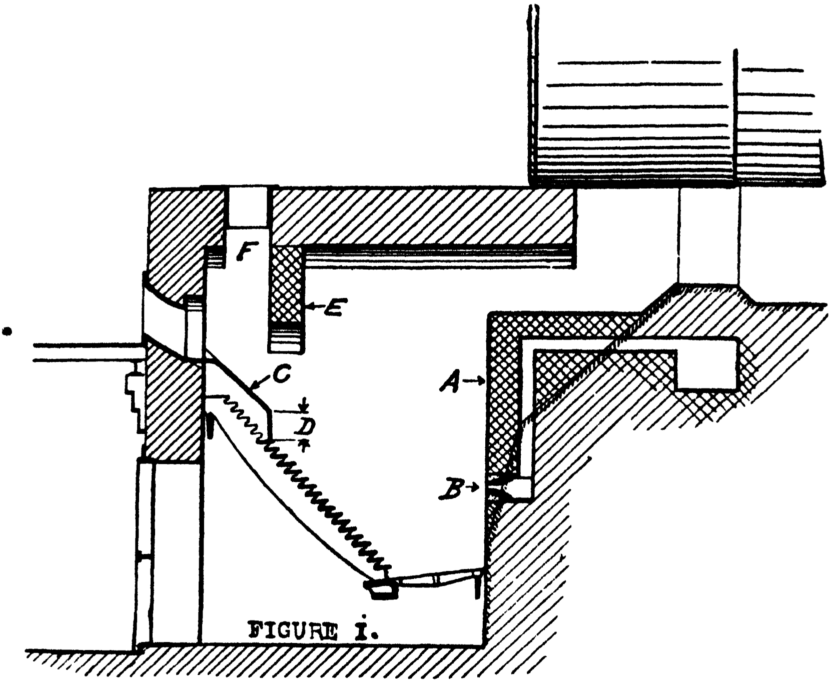

FIGURE I.

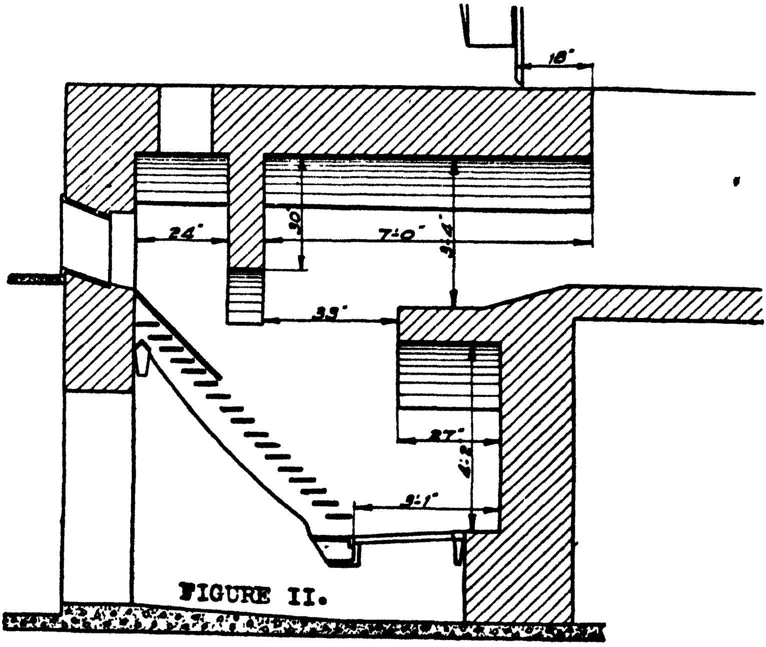

FIGURE II.

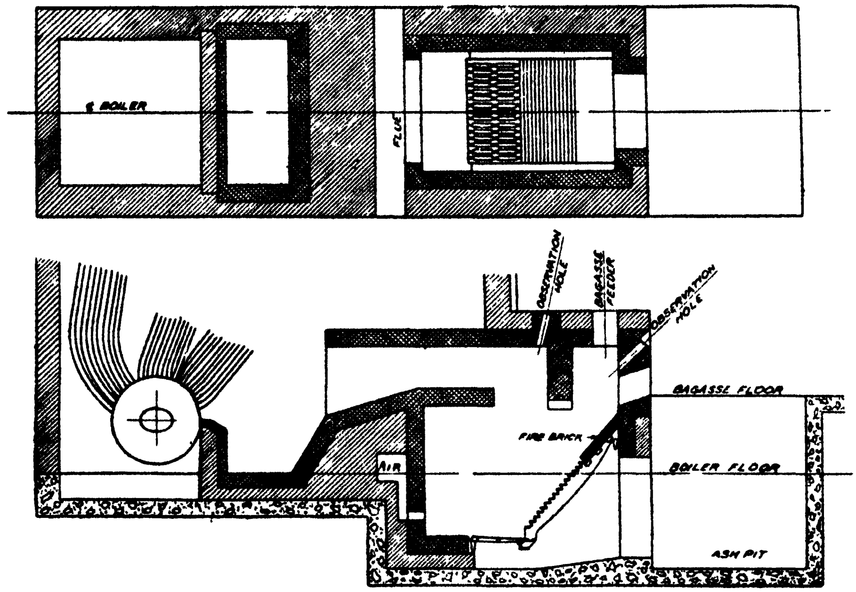

FIGURE III.

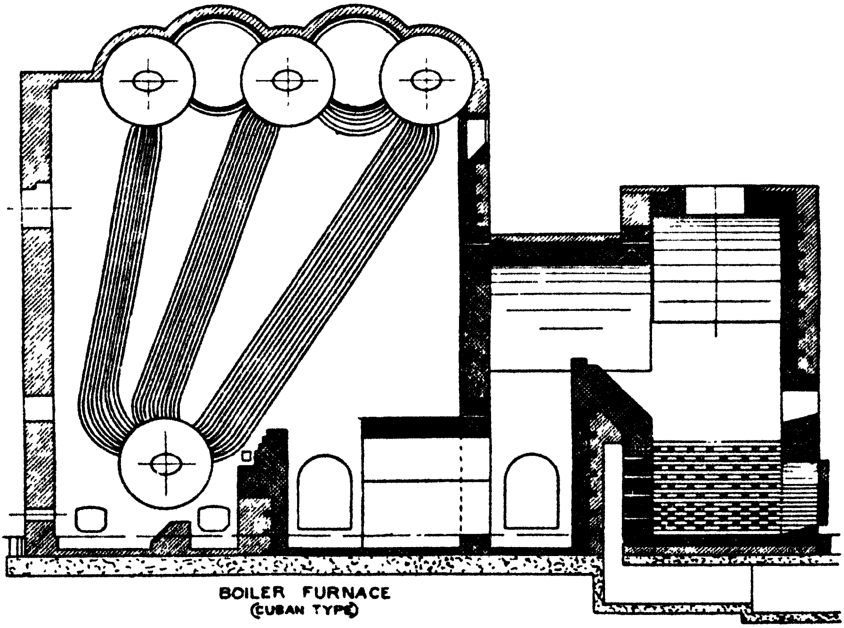

FIGURE IV.

	Onomea.	Pepeekeo.	Hakalau A.	Hakalau B.
1. Heating Surface, sq. ft.	8774	4387	12,064	12,064
2. Grate Area, sq. ft.	81·08	31·63	52·0	128·0
3. Draught, in. of water:				
Furnace	0·14	0 26	0·38	....
Damper	0·46	0·59	0·63	0·63
4. Moisture in Bagasse, per cent.	39·6	37·5	36·9	37·0
5. CO_2 in Flue Gases, per cent.	14·0	13·0	9·0	10·5
6. Flue Gas Temperature, degrees F.	460	490	530	520
7. Ratio, Grate Area to Heating Surface	1 : 108·2	1 : 138·7	1 : 232·0	1 : 106·1
8. Bagasse Burned per sq. ft. of grate	94·76	105·4	214·0	84·4
9. Bagasse Burned per sq. ft. of Heating Surface, lbs.	0·876	0·76	0·92	0·895
10. Equiv. Evap. per lb. Bagasse	3·28	3·32	2·849	3·22
11. Equiv. Evap. per sq. ft. Heating Surface	3·06	2·52	2·628	2·88
12. Per cent. of Boiler Rating developed	88·6	73·15	76·17	83 51
13. Efficiency of Boiler, Furnace and Grate	65·06	63·13	54·1	60·23

the combustion and general conditions of operation are better with the Cuban than with the Hawaiian type; it may be that the steam requirements of the factories in the Territory will eventually be such that this more efficient design will have to be adopted in order to obtain the best work. But for the present installations of the Cuban type are not considered necessary.

In some factories oil is burned in conjunction with bagasse in order to maintain the required steam pressure. With oil at its present price, it is desirable that it should be burned with the maximum efficiency. In order to do this, a furnace designed for the purpose should be used, and it should never be burned in conjunction with bagasse. While it may be expensive to change an ordinary setting, and install a proper oil furnace, the improved results will more than pay for the cost of the alteration in a few months' time, if any appreciable quantity of oil is burned.

Mr. James Crabtree, M.Sc., F.I.C., of the Woburn Experimental Farm, Apsley, Beds., has just been appointed Superintendent of the new British Guiana Sugar Experiment Stations, which have been authorized under an Ordinance of the British Guiana Government.[1]

Mr. Arthur R. Ling, F.I.C., F.C.S., has been appointed to the Adrian Brown Chair of Brewing at the University of Birmingham. Mr. Ling is well known as a consultant on brewing and malting, and as the author of some valuable papers on the ready-formed sugars of malt, on the action of diastase on starch, and on the physiology of the malting process. He is joint author of the standard work "Principles and Practice of Brewing," and is Editor of the *Journal of the Federated Institutes of Brewing*. He was Chairman of the Empire Sugar Supply (Technical) Committee, the report of which body was recently published.[2]

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[1] See *I.S.J.*, 1919, 536.

[2] *I.S.J.*, 1919, 448-453.

A Comparison of Cuban and Hawaiian Methods and Machinery.

At the request of the Hawaiian Sugar Planters' Association, Mr. Noël Deerr lately compiled a detailed account of the differences in sugar machinery found in Cuba and in Hawaii, which has been incorporated in the "Report of the Committee on Manufacturing Machinery for 1919" presented to this Association. Mr. Deerr's report is as follows.

To your request that I should supply you with some account of the differences in sugar machinery as found in Cuba and Hawaii, the natural reply would be to say that such do not exist, since the design of the individual units employed in factories of recent construction has become very largely stereotyped. What differences do exist are to be found only in these minor details which express the personal equation of the draughtsman. On the other hand, the operation of the factory and the economic conduct of a Cuban sugar property are very different from what we have been accustomed to in Hawaii.

The Cuban sugar industry is essentially one of extensive methods as opposed to the intensive routine followed in Hawaii. Its production of cheap cane depends on the planting of large areas to which is given, especially in the more recently developed lands of Eastern Cuba, a minimum of cultivation, and for which no expenses are incurred for either irrigation or manuring. The result is a small return of cane, which does not average over 20 short tons per acre, but which is at the same time produced for a very small cost per ton of cane. It hence follows that Cuban practice affords high profits per ton of cane or per ton of sugar simultaneously with small profits per acre. Hawaiian practice, on the other hand, aims at obtaining the maximum of profit per acre and at the same time decreasing the cost of production per lb.

A second allied difference is to be found in the relations between producer and manufacturer. Most of the cane grown in Cuba is raised by planters who sell the produce to the mill owners for the value of so much sugar, expressed as a percentage basis on cane; this percentage lies between the limits of 4½ per cent. and 7½ per cent. It is easy to say that under such conditions the manufacturer often will, and indeed generally does, make large profits when he works up the maximum possible quantity of cane at a moderate efficiency. Thus, 150 tons of cane bought on a basis of 6 per cent. and treated so as to give 11 per cent. yield will give to the manufacturer a profit of 2 per cent. of sugar on weight of cane, allowing 3 per cent. to cover all charges. The net profit therefore equals the value of 3 tons of sugar on the 150 tons of cane. On the other hand, the purchase of 100 tons of cane treated so as to obtain a yield of 11·5 per cent. would on an equal basis give the manufacturer a profit equal to the value only of 2·5 tons of sugar.

In Hawaii, however, the quantity of raw material available is fixed, and already the return of cane per acre does not seem capable of further increase, so that in order to augment his profits the Hawaiian manufacturer is confined to extracting as much sugar from the cane as is economical, having due regard to the prevailing prices of sugar, fuel and supplies. This condition, equally with that in the field, tends to increase the cost of production in Hawaii while still yielding the maximum of profit, and finally it may be said that the comparison between Cuba and Hawaii clearly shows that the low cost of production does not necessarily imply efficiency, but in this particular instance rather the reverse.

Turning now to the actual methods employed, I would offer you the following short notes upon which the bearing of the foregoing remarks will often be apparent:—

Harvesting.—In Cuba, the cane after cutting is loaded into bullock carts, the capacity of which is 7500 lbs., and which are drawn by two or more yoke of oxen. The cane is cut into 6 ft. lengths and is carefully packed in the cart, in which are placed chain slings, serving, with the assistance of a derrick, to transfer the load *en masse* to 30-ton standard gauge railroad cars. Actually a well-loaded car will hold 45,000 lbs. of cane, and a cane train will be made up of a maximum of 30 such cars. The distance hauled by the oxen seldom exceeds a mile, but the railroad haul to the central may be as much as 50 miles, and on an average is much larger than anything that obtains in the Hawaiian Islands. The great areas over which the Cuban sugar properties extend necessitate a standard gauge track, and the transport would not be economically possible with the narrow gauge roads sufficient for the more concentrated industry in Hawaii.

With the very great extension of the cane areas, combined with the lack of control following on the colono system, it results that a much longer time obtains between cutlass and mill in Cuba than is the case in Hawaii. In Eastern Cuba, at any rate, it is not uncommon for the mills to operate on cane at least a week old, and I do not think I am far wrong in putting the average age of the cane worked up as far as 72 to 96 hours. It is quite easy in the mill to trace the effect of this long storage, and here lies one of the economic losses, and one that is not generally recognized as such.

It is also worth while mentioning that in Cuba the harvesting of the crop frequently amounts to 60 per cent. of the total cost of production. Under harvesting in this connexion is included cutting, loading, hauling and transportation, and the statement particularly refers to Eastern Cuba, with cane sold at 5 per cent.

Unloading.—The endless belt rakes and reciprocating mechanical fingers used in Hawaii to unload cane have never been used in Cuba. The method now almost generally followed is the dump. The cars are built so that their sides may swing outwards. Hence on inclining the car the load will gravitate into a hopper or onto a carrier. To effect the discharge, a tilting platform is located alongside the hopper or carrier. Side or end dumps are equally in use, and the power used to operate the tilting platform is usually hydraulic. The unloading of cane by means similar to that used for transferring from carts to cars is now little used.

Milling.—Capacity, and not extraction, is the object of the Cuban mill. Whereas Hawaiian practice regards the milling plant as a means of extracting sugar, that of Cuba looks upon it as a means of grinding cane. This point of view follows from economic differences that have already been touched upon.

The quantity of cane milled in Cuba per unit of time appears at first sight very great, and at the present time there are a number of trains in Cuba operating at the rate of 200,000 arrobas per day in 84 in. outfits, consisting of a double crusher and five or six 3-roller mills. This quantity of cane reduces in Hawaiian terms to 104 tons per hour, and compares with the 65 tons milled in Hawaii in a 78 in. train. The best record of a prolonged run that I have seen for a double-crusher and six mills, 36 in. × 84 in., driven by individual motors, is:—

Tons cane per hour	117
Fiber per cent. cane	9·9
Water per cent.	11·9
Extraction	94·9

This represents the latest and best Cuban practice, and in comparison with Hawaiian work the very low fibre must be considered. The effect of the long train and the moderate quantity of added water in giving a reasonable extraction, and one which a few years ago would have been considered excellent practice in

Hawaii, is well shown. In making the comparison it must be remembered that the capacity of a mill increases much faster than does the length of a roller, and that the Crystalina cane of Cuba (Rose Bamboo in Hawaii) seldom contains as a crop average as much as 11 per cent. of fibre as compared with the 11·5 per cent. in Hawaiian Lahaina and 13·5 per cent. in Yellow Caledonia. If these differences are taken into consideration, the "duty" of Cuban and Hawaiian plants will be found to be much more even than the mere statement of the tonnage milled would imply.

On the other hand, the high extraction reached in Hawaii is never obtained, or even aimed at in Cuba. The highest figures that I have ever seen there were in the neighbourhood of 95 per cent., and I doubt if the average extraction all over Cuba reaches 93 per cent. The water used in maceration is seldom more than 20 per cent on cane, and frequently is zero or of the order of 5 per cent. The bagasse analysis also compares unfavourably with what is expected in Hawaii, and the percentage of water is seldom less than 47 per cent. This is, I think, rather to be attributed to the spongy absorbent nature of the fibre rather than to inferior milling. Reference to your Hawaiian statements shows with regularity that the lower percentages of water are found with Yellow Caledonia cane as opposed to Lahaina; that is to say, in cane with a larger proportion of non-absorbent rind tissue, as opposed to the softer absorbent interior pith.

The mills differ themselves in no way from the standard designs. Occasional examples of divergence are met with, as in the Delbert triangular housing, and in types in which the front and back rollers rest on surfaces at right angles to lines joining the centres of the top and lower rolls. In this type, both front and back rolls are supported on hydraulically-controlled rams.

Steam Plant.—The typical Cuban boiler, at least in the older houses, is one of size 22 ft. × 8 ft., so it hence affords about 40 per cent. more heating surface than does one of the size 20 ft. × 7 ft., which is standard in Hawaii. These boilers are frequently set in pairs, with a common furnace located between them. The path of the hot gases is underneath, back through the tubes and out over the top of the shell, the main flue thus being located at the back of the boiler and not in front as is usual in Hawaii. A second point of difference lies in the frequent use of the hearth as opposed to the step-ladder grate, the air necessary for combustion being admitted under pressure by tuyers round the hearth.

There would appear in Cuba to be no decided preference one way or another for either fire-tube or water-tube boilers, and the recent installations seem to be divided. The heating surface installed is similar to that used in Hawaii, and amounts to 450 to 500 sq. ft. per ton cane hour. A recent development is the preference for concrete chimneys as opposed to the steel stacks common heretofore.

Steam Utilization.—The majority of Cuban houses are laid out with isolated triples or quadruples, and it is only very recently that pre-evaporators or systems designed to "bleed" steam from an early cell have been put into operation. These systems have, however, been generally installed in the newer houses, the preference being toward the pre-evaporator piped so as to discharge directly into the exhaust main. Control systems of regulating valves, whereby a constant pressure on the exhaust line is maintained, form part of the equipment installed, but these systems have nothing of novelty for Hawaiian technologists.

A distinction from the Hawaiian houses lies in the distribution of the power required to operate the house. Almost without exception Cuban houses are short of water, so that the injection supply has to be pumped to a cooling tower or else atomized by sprays. Usually the condensers are built at an elevation of 75 ft.

with a seal to the waterleg at a 30 ft. elevation, whence the water flows to the cooling tower. As the quantity of cooling water amounts to 20 times the weight of cane, and all has to be pumped to a height of 75 ft. a power item of some magnitude is called for, resulting in the producting of an excess of exhaust steam for which a use must be found.

Almost all Cuban houses show a rather large fuel consumption, which reaches on an average 2 per cent. on cane expressed as wood. Much of this extra fuel is to be laid to the account of the low fibre in the cane, compensated (in comparison with Hawaii) by the much less quantity of maceration water used. Notwithstanding this, I do not think that usually the same heat economy is found in Cuba as in Hawaii, and one cause of this lies in the prejudice existing among Cuban boilers to carry the concentration of the syrup beyond 60° Brix, as an extreme limit, 55° being a far commoner figure.

Electric Drive.—The steam turbo-generator has become a part of routine design in all of the newer Cuban houses. In some, the electrification includes the mills; in others, it is confined to machinery other than the mills. In the absence of any centralization of power or long distance transmission, it is hard to see what economy is gained in the mill drive; nevertheless the electric control is very complete and by means of recording watt-meters a very exact control over the operation of each unit can be obtained, and any irregularity detected and corrected.

In the other parts of the house considerable opportunity is afforded for the ingenious grouping of units to be driven off a single motor by belt drive, though in some cases preference has been shown for individual motor drive throughout. Divergence of opinion is exemplified in centrifugal installations, some being found in groups belt driven off a motor, whereby a distribution of power is obtained; whilst in other cases, batteries of centrifugals have been installed, each having its own motor, in which case no averaging of power is possible.

On the most important phase of electrification, namely, steam economy, I regret that I have never had excess to really reliable data, but what few actual figures I have seen gave no indication of any superiority over those afforded by a well-designed steam-driven house.

Defecation.—The Cuban sugar master will always insist that it is impossible to obtain a good defecation with tubular heaters alone, and will protest that the application of live steam in coils is necessary. The Hawaiian settling tanks are therefore replaced by defecators provided with coils for use with live steam. They are often used in combination with heaters in which the juice is raised to 150° F., the completion of the heating taking place in the defecator.

Filtration.—The filter-presses found are of the plate-and-frame type essentially similiar to those in use in Hawaii. A layout in a French designed house presented some features of novelty. The scums were forced by a centrifugal pump to a receiver in which a constant pressure of 20 lbs. per sq. in. was maintained through the agency of a relief valve, permitting the return of the material to the supply tank. The presses were filled from this pressure tank. A second pump drew from the tank, and to its pipe-line the presses were connected after the flow of filtrate at 20 lbs. became slow. The pressure on this line was kept at 40 lbs. per sq. in. by means similiar to that already mentioned. After the presses were filled at 40 lbs. pressure, washing was effected with water at 60 lbs. pressure per sq. in.

Sugar Boiling.—A recent report from Dr. R. S. NORRIS capably covered the methods used in Cuba,[1] and to this I have nothing to add except to state that generally the boiling schemes tending toward the complete suppression of low products and elimination of their return to process are generally in more extended use than they are in Hawaii, or at least than they were during the time that I was in the Islands.

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[1] *I.S.J.*, 1919, 87.

Containers.—The Cuban bag of 325 lbs. has been frequently discussed in the meetings in Hawaii. The Japanese labourer is more robust than his colleague in Cuba, and I see no reason why a larger bag should not be adopted in the Hawaiian factories. Some reasonable economy should result from its use.

Finally I would advise you that there are many other interesting phases in which Cuban practice differs in details from Hawaiian, but to take up all the points would consume more space than you would be willing to spare.

Sugar Cane Work in Queensland.[1]

"During the present year the Sugar Industry has been marking time. The agreement with the Commonwealth by which £21 per ton is paid for raw sugar terminates at the end of this season. Sugar in every other country is now commanding very high prices; £50 per ton and upwards is being paid. The Australian consumers are, therefore, getting their sugar at very much lower rates than elsewhere, but, notwithstanding this fact, we see an agitation at the present moment amongst the jam manufacturers in the south for cheaper sugar. The Queensland cane farmer has never asked for war prices for his product, but has accepted the lowest price in the world for it. This should be remembered in his favour if prices are again fixed." These are the opening words of the Annual Report of Mr. H. T. Easterby, the General Superintendent of the Bureau of Sugar Experiment Stations, for the year ending October, 1919.

They reveal a curious and complex state of affairs, and hint at the constant state of tension which exists between the almost wholly tropical colony of Queensland and the more temperate states of the Australian continent. The sugar industry has, for some reason, always been subjected to political interference and this has, perhaps, been especially the case in the vast areas colonized by English-speaking races—the United States, the Union of South Africa, and the Australian Commonwealth—where smaller portions are within the tropics and the larger in temperate regions, and the most varied interests have to be brought into harmony. It is invariably a struggle between the demand by the bulk of the population for cheap sugar and an equally insistent demand on the part of the sugar producers for a living wage. In Australia, with its Labour Government, this contest has been particularly keen, and, although it is inconceivable that the sugar industry and, with it, the prosperity of Queensland will be extinguished, the incessant enquiries and awards brought about by the demands of labour during recent years will inevitable tell against any great expansion, unless the situation is handled with great care, the interests of the producers guarded, and the whole industry stabilized. The lot of the mill owners and cane farmers has not been an easy one for years past, and it is more than probable that capital, for some years to come, will be rather drawn in other, safer directions, where there is less chance of Government interference.

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[1] Annual Report of the Bureau of Sugar Experiment Stations for the year ending Oct. 31, 1919. Harry T. Easterby, General Superintendent. Also, the Australian Sugar Industry, Bulletin No. 7 of the Advisory Council of Science and Industry, Commonwealth of Australia, 1919. By Harry T. Easterby. (See *I.S.J.* 1919, 62-69).

The soil is fertile and well suited to the growth of sugar cane. It consists, in the main, of deep alluvia and thick layers of friable, red, volcanic strata. But the climate is uncertain and, in the more southern tracts, where the industry had its birth, distinctly less suited to the crop, on account of frosts and severe droughts. This uncertainty has led to great variation in the production of sugar in different years, and adds to the difficulties of the planters and manufacturers. The accompanying table speaks for itself, and it is illuminating that no safe prediction as to yield can be made beforehand. It was expected that the production in 1918 would equal, if not exceed, that in the record year of 1917, whereas it fell short by some 117,000 tons of sugar.

PRODUCTION OF SUGAR IN QUEENSLAND.

1901	120,858	1910	210,756
1902	76,626	1911	173,296
1903	91,828	1912	113,060
1904	147,688	1913	242,837
1905	152,722	1914	225,847
1906	184,377	1915	140,496
1907	188,307	1916	176,973
1908	151,098	1917	307,714
1909	134,584	1918	189,978

Just now, when it is extremely important that consumption (280,000 tons?) should be met by production, prolonged droughts and, in the south, severe frosts are upsetting all calculations, and the yield for 1919 is not likely to exceed 155,000 tons. There is naturally a tendency for the whole industry to move northwards, where the rainfall is greater and frosts are no longer feared, and it is here that the bulk of the large, new, up-to-date factories are situated.

The expulsion of coloured labour in the early years of this century, owing to the ideal of a "White Australia" being imposed on Queensland upon her entering the Commonwealth, was a severe blow to the industry. But on the whole it cannot be considered as an unmixed evil, for it caused the sugar planters to put their house in order and has been the prelude to a great expansion and a much better class of work all round. The large estates were cut up and the growing of canes was put in the hands of a sturdy, hardworking set of cane farmers, quite distinct from the factories. The latter have greatly increased in size, and numbers of the smaller inefficient installations have had to close down. There are over 4000 cane farmers in Queensland cultivating, on the average, 39 acres apiece. In 1866 there were 166 factories, but at present there are little over 40 and the process of weeding out is still proceeding. The output of sugar during the same period increased from about 50,000 tons to anything from 150,000 to 300,000, although the mills are not yet fully supplied with canes. It is estimated that only about one third of the valuable sugar land is occupied, so there is room for a great further expansion if the conditions are made favourable for export. But the demands of labour and the cry for cheap sugar are as yet by no means satisfied, and it is not surprising that there is a strong tendency, in the northern, tropical regions, for the farms to pass out of the hands of the British settlers into those of other nationalities, chiefly Italians. In the Johnstone and Herbert River basins it is estimated that 75 to 90 per cent. of the labour is foreign, while 30 per cent. of the farms are held by other races, and it is recorded that 99 per cent. of the purchasers of farms during recent years have been Italians. What this may mean to the Commonwealth with its immense line of unprotected coast may be gathered from the details of enlistment in the last war. In the two great sugar tracts of

Bundaberg and Mackay one eighth of the population joined the army, and Mr. EASTERBY points out that, if this proportion had been equalled in other parts of Australia, an army of 500,000 would have entered the field. As there is no other crop which can take the place of sugar on the coastal lands of Queensland, this foreshadowed alienation of the industry seems to suggest strong political action on the part of Government, and their forthcoming decisions will be looked on with special interest by English speaking races. Meanwhile, the sugar industry in Queensland is "marking time."

Mr. EASTERBY, in reviewing the whole situation, compares the results in Queensland with those obtained in Hawaii and Java. He claims that in the excellence of the varieties grown, as judged by their sugar content, the planters have nothing to fear from these two countries, while the newer factories are not inferior to any in the world. But there is much to be done in the matter of cultivation and the yields are comparatively low, the factories, as already stated, rarely being able to work to their full capacity. This is, naturally, traced to the existing system of small cane farmers, for these are men of little capital; manures and implements are at present almost beyond their means and the minimum of the troublesome labour has to be employed. Most of the estates are at present unmanured, and while this is a striking testimony to the richness of the soil, cases are by no means uncommon of farms going out of cultivation through rapid exhaustion. There are also serious pests attacking the canes, and these have added to the list of abandoned properties, even where the soil is still capable of producing paying quantities of cane.

All of these points are clearly set forth by the indefatigable Superintendent of the Bureau of Experiment Farms. The duties of this officer and his small staff are manifold, and range from fighting a political propaganda to the latest experiments in agricultural practices and up-to-date work in circumventing the attacks of various cane pests. A great deal of Mr. EASTERBY's time is taken up with meetings of farmers' associations, and the closest contact is thus established between the department and the cultivators; the latter show the keenest interest and are fully alive to the necessity of improving the cultivation within the limits of their means, and testing the new kinds of cane placed at their disposal after trials on the Experimental Stations. The Assistant to the Superintendent is constantly touring among the farmers, studying their local conditions and giving advice as to possible improvements in their practice. How thoroughly this work is being carried out may be best understood from the list of enquiries which the field assistants have to make. Reports on this questionnaire have been sent in to the Bureau from nearly 1400 farms, and a flood of light is thrown on the work of the department by its study. The main problem is to produce more cane per acre with the minimum of labour. The following has been extracted from Mr. EASTERBY's report:—

NOTES UPON FARMS VISITED.

(*a*) *Soils.*—Classification, type, colour. Are they shallow or deep, forest or scrub, dry or wet? Condition of tilth, nature of subsoil; acidity or alkalinity of soil to be tested with litmus papers. Presence of rocks, gravel, stones, and washaways.

(*b*) *Crops.*—What number of cane crops have been grown, and during how many years? What are the highest and lowest tonnages of cane secured? Does land grow good crops at present time; and, if not, to what does the farmer attribute the reason?

(*c*) *Lime.*—Ascertain if any farmers have used lime, and what the results have been; also note if there are any probable sources of lime on the district.

(*d*) *Green Manures.*—What farmers are using green manure? What crops have been or are being grown, and with what success as to the crop itself, and its after-effect on the cane crop?

(*e*) *Fertilizers.*—What (if any) fertilizers are being used? Times of application, in drills with cane, or at sides of rows? what quantities are employed? Are machines used for the purpose; if so, what type; or is application by hand? Has application been successful?

(*f*) *Drainage.*—Is any form of drainage used; if so, of what nature?

(*g*) *Irrigation.*—Is irrigation in use? How much applied per acre at each watering? How applied?

(*h*) *Weather.*—Rainfall statistics. Notes of heavy rains can be made, severe winds causing damage to cane, thunderstorms, frosts, floods, &c.

(*i*) *Ploughing.*—How many ploughings are usually given? Types of ploughs. Are disc or swing ploughs most common? Diameter of disc in general use. Make of disc most favoured. Are any motor ploughs or steam ploughs in use; and, if so, are they successful? Get details as to cost of ploughing per acre where possible. To what depth is it usual to plough? Is ground usually stirred by a subsoiler below the ordinary depth reached by the plough?

(*j*) *Planting.*—Are top plants usually taken? Number of eyes on each plant, width of rows, and distance between plants. Do farmers use cane-planters? What depth is the furrow in which the cane is planted? Are canes laid on hard bottom, or is some earth left; and, if so, how much? What are the shallowest and the deepest coverings used? How are the plants covered—by hand or implement? How much cane is used per acre? Do farmers change plants to any extent? Average cost of planting.

(*k*) *Cultivation.*—What implements are in general use? Are cultivators generally fitted with digging tines, or broad sweeps, or hoes? Is the plough used to any extent between the rows? Are disc harrows or other cutting machines in use? Note what damage, if any, is caused to roots of growing cane by these latter implements. What is the common depth to which cultivation is carried? Average cost of cultivation, including that done by hand.

(*l*) *Harvesting.*—What are the current rates paid in each district for harvesting? Is it the general practice to burn cane before cutting? Is much top or cabbage left? Are canes cleaned from trash before going to mill? Are stools cut well below the ground?

(*m*) *Labour.*—State general feeling as to labour in each district.

(*n*) *Trash.*—Is trash usually burned? If not how is it treated?

(*o*) *Ratooning.*—How is ratooning done? Do any farmers volunteer ratoons; and, if so, what percentage?

(*p*) *Pests and Diseases.*—Note what pests, vermin, or diseases are prevalent in each district, and what is being done to combat same.

(*q*) *Varieties of Cane.*—Note the varieties of cane and behaviour of each in every district.

(*r*) *Arrowing.*—Note time of arrowing of different varieties each year.

In pursuance of these instructions the Field Officers have so far sent in reports upon 1,391 farms. Upon these 153 farmers have used lime, 344 have practiced green manuring, and 287 have used fertilizers. The percentage of growers using lime, green manures, and fertilizers is much higher in the North than in the South. Now that the indications are that fertilizers will probably be much reduced in price, it is hoped that a much freer use of them will be made.

The work of the Bureau is thus seen to be to a great extent agricultural, and, as we shall see later, cultivation is receiving marked attention from the Entomologist, Mr. ILLINGWORTH, in his fight with the very serious white grub pest, and with very encouraging results. This is in strong contrast with the line of work recently noted in Porto Rico where the same pest is assuming alarming proportions.

Sugar Cane Work in Queensland.

There are three Experiment Stations in the Colony, representing the chief sugar centres:—Bundaberg, Mackay and Innisfail, situated roughly in south latitudes 25°, 21°, and 17° respectively. The narrow coastal belt of Australia on which sugar cane is grown extends for some 2,000 miles in a northerly or north-westerly direction, although there are gaps in which sugar cane is not planted, and this ground is covered by the three stations. The climate in the tract differs greatly. The rainfall decreases markedly as we proceed southwards. At Cairns in the north it averages 92·65 inches, but increases a few miles south, on the Johnstone River, to over 150. Innisfail is situated here. At Mackay it averages 66·67, and at Bundaberg 44·40. The recent drought was of advantage in the region of excessive rainfall while, elsewhere, it was more or less disastrous, both for the current crop and next year's planting. At Bundaberg it reached only 24·16 inches the lowest recorded since the founding of the station, and most of this fell out of the growing season. In his tour of inspection through the districts, the Superintendent saw beautiful stands of canes at Innisfail and Babinda, while everywhere else the fields were dried up and withering, and planting was being much delayed, auguring ill for next year's crop. The winter months are mild and pleasant in the north, but occasional frosts are met with in Mackay and these are usually severe in the Bundaberg tract and south of it. From these data it will be seen that the class of work required is different in the three stations. That at Innisfail has only just been started, in response to the northward movement of the industry and, from the programme laid down, the first line of work will be the trial of the cane varieties at present existing in the Colony, together with the commencement of the raising of seedlings. This latter work is perhaps less needed in Queensland than anywhere else because of the fine series of canes already collected, largely from New Guinea. In Bundaberg and Mackay the work is mainly agricultural, in the former case being more prominent. The experiments for the year included liming, sub-soiling, manuring, planting by hand and machine, after cultivation versus none on the light red soils, planting of tops, middles and bottoms, and the trial of varieties. Some of the facts elicited are of interest. Liming has thus far had little effect and, as larger amounts are used in Hawaii, it is suggested that the quantities applied have been too small. An experiment has accordingly been laid down for next year, with additions of lime from 1 to 6 tons per acre. The advantages of manuring are obvious, but this does not appear to be the case with plant canes. With these it has shown little result, while its effect on the succeeding ratoons is very marked. The experiment is now being tried to determine whether it is better to manure the plant canes or to delay the application and give it direct to the ratoons. The relative advantages of hand and machine planting of the sets has not as yet been decided and the experiment is being continued. The use of tops gives a much better yield of canes. The experiment were, however, conducted with only one kind of cane, the valuable Badila from New Guinea. We think that it might be worth while to test other varieties as well, for experience in India has shown that the value of top-planting varies with the kind of cane. Thus, while the planting of pieces of the cane is almost universal, and gives the most satisfactory results, this method was found to be quite useless with one kind, namely, the "Seema" of the Godavari district. We would suggest that the experiment be repeated with D. 1135, as that cane is apparently most favoured in the southern districts, while Badila is a more tropical cane and the chief favourite in the north.

Of the varieties tested two cases are selected here for special remark. The celebrated Hawaiian variety, H. 109, has given very poor results both in richness of juice and yield of canes. It is well known that it is not uncommon for an introduced cane to take several years to accustom itself to new surroundings, and we are glad to note that it is proposed to continue the growth of H.109 in the hope that it may improve. On the other hand, an Indian cane, sent by Mr. CLARKE from the United Provinces, and named Shahjahanpur No. 10, has given surprisingly good results. Mr. EASTERBY reports it to be a good striker and ratooner, a rapid grower with great drought resistance and not easily affected by frost. Last year it was beautifully green when all the other kinds were frosted to the ground. This fact might be considered as sufficient to account for its beating all the other kinds in the analyses of its juice, but the latter came out extremely well independently of the character of the season. The fibre was rather high but, in total soluble solids, sucrose and glucose in the juice, purity, sucrose and commercial sugar in the cane, it gave very much better results than is usual for indigenous canes in India itself. We have no knowledge of this variety, but presume that it was selected by Mr. CLARKE from the numerous *Ganna* canes of the United Provinces. It would be interesting to learn whether it too, like the Yuba and Agoul of Natal and the Kavangire and perhaps other thin canes of Brazil and the Argentine, belongs to the North Indian Pansahi group of canes. It may well turn out that the future of the cane industry in the frosty, drought-stricken southern portions of Queensland may be dependent, as in Natal, on canes of this character.

It remains briefly to notice the work of the Entomological section under Dr. ILLINGWORTH. This, unfortunately, is becoming of the utmost importance to the cane industry in Queensland, because of the serious damage caused by white grub. The loss in Cairns due to this pest is given as from 25,000 to 30,000 tons of cane each year, and to this must be added the fact that in some places what appeared to be magnificent cane lands have gone out of cultivation entirely owing to the attacks of the grubs on the cane roots. The main lines of the campaign are summarized as follows:—Improving the health of the plants, the application of manures and lime, increasing the humus of the soil and removing feeding trees of the beetle to at least half a mile from the fields. Dr. ILLINGWORTH claims to have demonstrated that the grub is primarily a humus feeder, and that, if this substance is increased in the soil, it will not attack the cane roots at all. Collecting the grubs and beetles, on which large sums of money have been expended in the past, is useless, for, as in the Nilgiri Hills in South India, the natural home of the insects is the neighbouring grass lands from which new hordes are constantly driving down to the plains. The well marked affinity of humus with arsenic opens another line of attack, for Dr. ILLINGWORTH asserts that 20 pounds of arsenic will clear an acre of the grubs to which arsenic is a deadly poison, if humus is present. Light cultivation of the surface during the egg-laying season and when the young grubs are small and near the surface has been found to be most beneficial; and the arrangement of the planting season can be altered so that the land is capable of being worked over with Planet Junior hoes at this period without injury to the canes. Finally, the removal of feeding trees from the cane land has proved to be an almost certain remedy. These are all of them straight lines whose usefulness can be easily tested, and it is to be hoped that Dr. ILLINGWORTH may be able not only to stay the invasion but add considerably to the yield of canes for the mills. It would be interesting to know whether the beetles on the wing have any preferences in the matter of "feeding trees," for there are many advantages to be obtained in tree planting in or near sugar estates, as was pointed out in last month's number of this Journal.[1]

C. A. B.

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[1] *I. S. J.*, 1920, page 131.

Correspondence.

THE IDENTITY OF CANES GROWN IN ARGENTINA.

To the Editor, "The International Sugar Journal."

Sir,—The note from Mr. Fawcett appearing in the March number of this journal is welcome as clearing up a recently introduced misunderstanding. As culpability for this is assigned to the writer, the following explanation will be in order.

In 1910 when preparing the manuscript of "Cane Sugar" I wrote to the late Dr. Kobus asking him to supply me with such descriptions of the more prominent Java seedling canes as would serve to establish their identity. Dr. Kobus very kindly gave me the information asked for. His letter and descriptions still remain in my possession, and comparing the original with the P.O.J.36 as it appears in "Cane Sugar" I find that the copy is letter perfect therewith.

My object in going to this trouble was to place in an accessible record accurate descriptions of varieties which might eventually become prominent, and so to anticipate future confusion. The note from Mr. Fawcett indicates that my well meant efforts have brought about the very combination that I was trying to avoid.

I regret that I have innocently contributed to confusion, but as the description I gave was "too brief to be of any real value" my error may perhaps be condoned.

Noël Deerr.

CHEMICAL CONTROL RESULTS IN CUBA.

To the Editor, "The International Sugar Journal."

Sir,—We read with interest in your January issue your article headed "Notes on the Sugar Industry in Cuba." We beg leave, however, to submit a few observations regarding the Table on page 20 headed "Control Figures of Six Typical Cuban Mills." We understand that factory 4 must be our own factory, Ermita, as it is our figures which are given there, with however a few mistakes, which we point out in statement herewith attached.

A glance at the right figures will show you your mistake in putting Ermita fourth. We occupied, last year, the first rank in Cuba and still retain it this year. The recovery of 96° sugar per cent. sucrose in juice was last year at Ermita 97·68 per cent.; our figure 93·77 given in your statement is the recovery in 100 per cent. sugar, or pure sucrose. Our total recovery in 96° sugar per cent. of the sucrose in the cane was 92·58, i.e., above the result of the other factories; our figure 88·87 given in your statement being also the recovery in pure sugar. The total sucrose in cane was 12·63 and not 14 as you figured it, also our fibre was 10·93, not 7·96 as you make it.

You are perfectly right in stating that some of the departments in the Cuban factories show up well, as regards quality of work, while in others there is room for much improvement. As a matter of fact, we had injenios last year that had a very high percentage of sucrose extraction at the mill, i.e., about 96 per cent. of the sucrose in the cane, but in these very mills the manufacturing was not up to the grinding and their total recovery suffered from this. This year one factory in Cuba is having a retention in manufacturing as high as 95·79 per cent., but their extraction at the mill is poor, and this factory, so far, comes next to us as a total result.

Thinking that the above will be of interest to you, we beg to remain,

Very truly yours,

Ermita Sugar Corporation.

Ermita, Oriente, February 25th, 1920.

[⁂ Our Cuban correspondent was responsible for the figures printed in our January issue, and these were given as of six typical Cuban factories, but were not named. Doubtless the Ermita Sugar Corporation are right in assuming that No. 4 referred to their factory, and we are glad to give them the opportunity of rectifying certain of the figures; but we do not think it was intended by our Correspondent to arrange these factories in any order of merit, so that it was quite by chance that Ermita, which claims to occupy the first rank in chemical control results, was placed in the fourth column.]

Publications Received.

The Simple Carbohydrates and the Glucosides. By E. Frankland Armstrong, D.Sc., Ph.D. Third edition. (Longmans, Green & Co., London.) 1919. Price 12s. net.

We are pleased to notice the appearance of a third edition of Dr. ARMSTRONG's monograph on the present position of the chemistry of the carbohydrates. Since the publication of the last edition,[1] when we discussed the scope and purpose of the book, there has been considerable activity in the subject. The discovery of a third isomeric form of glucose differing from the pentaphane ring forms in structure, probably containing a three-membered (triphane) ring, opens up ways to much future work, and in particular has served to elucidate that very vexed problem, the structure of sucrose. The relationship of optical rotary power to structure in the case of the carbohydrates has long been a source of speculation; but, because of the indifferent manner in which many of the carbohydrate derivatives had been characterized, nothing definite had been achieved until recently. Owing to the work along this line carried out by HUDSON and others, we are now in possession of many of the necessary data, and the generalizations of this chemist have given a new and most promising aspect to this field. Moreover, some of the rarer sugars have been made more available, thus stimulating enquiry. Indeed, as methods of investigation improve, and more attention is paid to the composition of plant products, the occurrence of the scarcer sugars is found to be far more general than had been anticipated, and it may be prophesied that future researches in this direction will be very fruitful. In particular much progress has been made in establishing the structural formulae of the disaccharides.

Laboratory Manual of Elementary Colloid Chemistry. By Emil Hatschek. With 20 illustrations. (J. & A. Churchill, 7, Great Marlborough Street, London, W.) 1920. Price: 6s. 6d., net.

Although most textbooks of colloid chemistry necessarily devote some space to experimental procedure, no laboratory manual (such as has been found indispensable in the teaching of other branches of chemistry and physics) has yet appeared. This work is intended to fill the gap. It supplies accurate and detailed directions for making a number of representative preparations, and for examining them by standard methods. Thus, chapters are devoted to dialysis; preparation of sols, gels, and emulsions; ultra-filtration; optical methods of examination; electrolyte precipitation of suspensoid sols; protection; and adsorption. Generally, the examples chosen are the simplest ones (where alternatives are possible), and those demanding the smallest expenditure in apparatus and material. At the end of each section, references are given to recent literature recording experimental investigations, which are either alternative to, or more advanced than, the examples in the text. Mr. Hatschek's small book is excellent. It will be much appreciated, especially by students of different branches of science who are finding some training in colloid chemistry an indispensable part of their equipment and who are able to devote only a limited time to acquiring its technique.

Patents and Designs Act, 1919 (9 and 10 Geo. 5. Ch. 80). (Eyre and Spottiswoode, Ltd., London.) Price: 3d.

This Paper sets forth the numerous alterations in British Patent Law, the most important of which were summarized in a recent issue of this Journal.[2]

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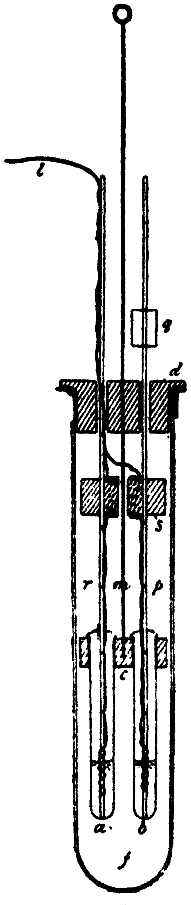
[1] *I.S.J.*, 1910, 257; 1913, 187.

[2] *I.S.J.*, 1920, 68.

Review of Current Technical Literature.[1]

CRYOSCOPIC METHOD FOR THE DETERMINATION OF SUCROSE, ESPECIALLY IN SMALL QUANTITIES OF PLANT SAPS. *Henry H. Dixon and T. G. Mason. Scientific Proceedings of the Royal Dublin Society, 1920, 16, (new series), No. 1, 1-8.*

A given quantity of sucrose in a given volume of water causes a certain depression of the freezing point that is approximately doubled after inversion. It is evident, therefore, that by two cryoscopic observations (before and after hydrolysis) the sucrose content of a liquid can be determined. This principle may be put into operation by the thermo-electric method of cryoscopy previously described by one of the authors, by means of which a high degree of accuracy is attainable.[2] Inversion is effected with invertase, and only 2·5 c.c. of the juice or other liquid under examination is necessary. This quantity of liquid is mixed with about 0·3 grm. of invertase[3] in the cold without allowing the temperature to rise above 0° C., and the freezing point is determined; then the mixture is incubated for 48 hours at 30° C., and the second cryoscopic reading made. Removal of the proteins and other colloids present in the juice is necessary. Readings of temperatures may be obtained with the error of +0·003° C., and 0·01° C., corresponds to 0·2 per cent. of sucrose. This method has been elaborated by the authors for work in connexion with the osmotic pressure of plants, and it is especially applicable to such investigations.



It is of interest to refer to the previous paper published in 1911[4] in order to obtain some particulars of Prof. DIXON's procedure. His thermo-electric method is a differential one, that is, comparative of the f. pt. of the solution being examined with that of pure water under the same conditions. Eureka-copper junctions are used, being connected with a galvanometer in the usual way, as few contacts as possible being made. It was found necessary to exercise some special precaution to secure that the junctions at the binding screws, and those in the galvanometer are at the same temperature, it being noticed that the different temperatures of the opposite sides of the galvanometer in an ordinary laboratory could cause quite an appreciable deflection. In order to remove this source of error as fully as possible, the galvanometer is placed in a thermostat. Turning to the illustration, the apparatus used in the actual f. pt. determination is shown. At *a* and *b* are two test-tubes containing the solution and distilled water respectively with the thermo- couples fixed in position, these tubes being immersed in a larger test-tube forming the freezing chamber *f*, which in turnis placed in a freezing bath. At *c* is indicated the cork bung supporting the two test-tubes, while *m* is the metal rod supporting it; *r* and *p* are pine rod supporters of the thermo-junctions; *s* a cork connecting-piece; and *l* is the line of leads passing to the galvanometer placed in circuit. In making an observation, the contents of the two test-tubes are cooled just below their freezing points, and separation of ice is started by adding a little hoar-frost on a cooled platinum needle. Lastly, after stirring the two liquids by moving the pine rods up and down, the galvanometer readings are taken.

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[1] This Review is copyright, and no part of it may be reproduced without permission.—(Editor, *I.S.J.*)

[2] *Scientific Proceedings of the Royal Dublin Society*, 1911, 13 (*new series*), No. 4, 49-62.

[3] Prepared by Davis' method, *I.S.J.*, 1916, 166.

[4] *Loc. cit.*

AUTOMATIC CONTINUOUS FILTRATION OF DECOLORIZING CARBON ("NORIT"). *H. B. Vollrath. Facts about Sugar, 1920, 10, No. 6, 110-111.*

It is argued that it is advantageous to use a large quantity of decolorizing carbon. If, for example, 1 per cent. (on the weight of dry sugar melted) is added, the rate of filtration may be such that 5 tons of sugar in the form of 60° Brix (33·3° Bé.) syrup is passed in one hour through a press lined with cloth having a filtering surface of 500 sq. ft., the colour removed being 85 per cent. of that originally present. If (on the other hand) 5 per cent. be used, the rate is 20 tons per hour, and the decolorization 95 per cent. When 1 per cent. is added, the carbon may be used only once before reburning, but in the case of 5 per cent. it may be used 10 times without washing or revivification, giving an average percentage of 0·5. When (however) 25 per cent. is added, so much liquor may be treated that the average percentage becomes about 0·2, and the rate of filtration and degree of decolorization are still equal to (or perhaps better than) those attained by 1 per cent. used once.

Difficulties arise when filtering a large proportion of carbon like 25 per cent. in the ordinary plate-and-frame press, due to the limited capacity of such apparatus, a large number of units being necessitated, so that labour charges are increased. Moreover, in press work well trained workers are required, and careful supervision is necessary at all times. An automatic continuous filter[1] has been invented to obviate such disadvantages. It consists of a steam jacketted horizontal cylinder, within which is a mixing device consisting of a shaft provided with paddles and a few baffle plates. Placed above the cylinder is an uptake at the top of which several filter leaves are suspended vertically. A scraping device operates on each side of each filter leaf while the filter is running. Inlets are provided in the cylinder for the carbon and the liquid under treatment, and there is an outlet to drain off the exhausted carbon. Spouts and faucets attached to the filter leaves carry off the treated liquid into a trough fastened to the uptake. In using this apparatus, a large amount of the carbon, is pumped into the cylinder, and following this the syrup under treatment, decolorization then taking place at the desired temperature attained by means of the steam jacket. As the pumping is continued, the carbon begins to ascend the uptake; the large portion remains in the cylinder, while the rest is carried along by the liquid ascending the uptake. A certain amount is carried up till it reaches the cloth on the filter leaves, where it tends to build cakes, which are scraped off as they form, leaving only a film ⅛ in. thick to insure a clear and brilliant filtrate.

After the apparatus has been in operation a certain time, the filtrate no longer shows the desired degree of decolorization, though the carbon may not be fully exhausted. It is by using 3 of these continuous filters in series that the full adsorptive capacity can be attained. When the liquor coming from No. 1 apparatus is running darker than desired, it is sent to No. 2, previously filled with 25 per cent. of carbon; and when that from No. 2 no longer reaches standard, it is connected up to No. 3, No. 1 being the cut out of the series. Lastly, the carbon is washed with water in a centrifugal, in order to free it from sugar, and passed to the regenerating plant. One man, it is claimed, can take charge of the battery, which may have a capacity of 300 tons of sugar per day. Refining is greatly simplified; because, the liquor obtained on melting sugar after washing it in centrifugals is passed through wire strainers, which are automatically scraped; into No. 1 continuous filter; and then into the vacuum pans. Bags or presses for the filtration of the liquor from the blow-up; char cisterns and char reburning kilns are all obviated.

In a boneblack refinery melting 300 tons of sugar per day, 150 to 300 tons of char per day may be in use, 150-300 tons will be washing, and another 150-300 tons reburning. In a refinery of the same capacity using "Norit" in conjunction with this special continuous filtering apparatus, each machine will have in use 1½ ton, or 3 tons in the 2 which are working; while there will be 1½ ton in the machine standing by. Only 1½ ton will be reburned per day; and the total stock of carbon is only about 10 tons, compared with 600-1000 tons of animal charcoal.

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[1] For which patents have been applied by the General Norit Co., of Amsterdam.

Review of Current Technical Literature.

ACTIVATION OF CARBON (FOR THE POSSIBLE PREPARATION OF DECOLORIZING CARBONS)

N. K. Chaney. Journal of the American Electro-chemical Society, 1919, 157-166.

During the war considerable attention was given to the preparation of adsorbent carbons for use in masks as a means of protection against toxic gases in the battle-field. Much useful work was done in America in this direction by the Bureau of Mines[1] and the Chemical Warfare Service[2]; and the result of this intensive research was the gradual development of a general hypothesis explanatory of the nature of active carbon. It rests upon the following two postulates, stated to have been experimentally established, viz.: (1) that elementary carbon (other than carbon and graphite) exists in two modifications, active and inactive (here termed *alpha* and *beta* forms respectively): and (2) that all "primary" amorphous carbon consists essentially of a stabilized complex of hydrocarbons, adsorbed on a base of active carbon. Active and inactive carbons differ one from another in two important particulars, namely (*a*) the temperature of formation, and (*b*) the chemical activity, especially susceptibility to oxidation. Active carbon is formed by deposition at relatively low temperatures, generally below 500° or 600° C.; while it is held that the inactive modification results from decomposition at higher temperature, usually 600° or 700° C. Oxidizing agents rapidly attack the active form, even slowly at room temperature, Dr. HULETT asserts, but the inactive form (like graphite in this respect) is relatively stable. It would be premature to state that these two forms of carbon are true allotropic modifications; nor has it yet been established that both are amorphous. Attempts to find a transition temperature, or otherwise to convert the *alpha* to the *beta* form, have been tried (using temperatures as high as 1600° C.), but without definite success Hydrocarbons, as methane, ethylene, or benzene, the decomposition point of which is above 700° C., in general give only inactive carbon; while others, such as acetylene, which may be "cracked" as low as 300° C., may give an active carbon at a low and an inactive one at a high temperature. It would seem that the temperature at which the molecular carbon is set free is apparently the controlling factor in determining which variety shall be formed.

Coming to the theory of "primary" carbon, it is pointed out that in the ordinary process of distillation of carbonaceous materials at relatively low temperatures active carbon is first formed, but by virtue of its adsorptive properties it takes up hydrocarbons, which become so stabilized that they are retained, whereas under conditions of temperature, pressure, etc., they would quickly be eliminated or decomposed. For example, considerable amounts of a hydrocarbon resembling anthracene (the boiling point of which is 360° C.) have been isolated from cedar charcoal which had previously been calcined to 850° C. Further, chlorine substitutes of hydrocarbons may be obtained by passing chlorine gas at high temperatures over cocoanut or other chars which previously have been heated to a similar temperature. These facts illustrate the power of active carbon to "stabilize" its adsorbed materials. This stabilized complex of hydrocarbons, adsorbed on a base of active carbon, is the product defined as *primary* carbon, being the original product occurring in low temperature distillation of carboniferous materials. Many grades of animal and vegetable charcoal are of this character, as are also cokes resulting from the low temperature distillation of bituminous coals, mineral bitumens, and the like. Sudden heating of primary carbon to a very high temperature results in the decomposition of the adsorption complex with sudden liberation of its hydrocarbons at temperatures much above their normal decomposition point, causing them to break down and form inactive carbon upon the active variety. Such a product is termed a *secondary* carbon.

Activation may consist in the separation and removal of the hydrocarbons from the active carbon; but in practice this is extremely difficult. Prolonged heating for days under carefully controlled conditions partially accomplishes the desired object, yielding an impaired and "gas-treated" product, containing a small amount of active carbon. There is another method of activation suggested by the theory, namely differential oxidation; and it has been shown that the adsorption complex can be broken down and the hydrocarbons oxidized or partly distilled off. Both the yield and quality of active carbon, however, have been found to vary greatly with the nature of the oxidizing agent and the manner of its control. Developments of this principle have been worked out by the author on the commercial scale, and adopted by the Chemical Warfare Service, these consisting in the air and steam processes, and later the use of carbon dioxide. Theory suggests the addition of chemical reagents to act catalytically during carbonization to break down the stabilized hydrocarbons, and this method was successfully employed to duplicate the enemy war charcoal, which was made (it was afterwards found by the Army Commission visiting Germany) by impregnating wood with various metallic salts before carbonization, later extracting with acid. This method really gives a small amount of active carbon, in comparison with the best methods of selective oxidation. On the other hand, the extraction of the dispersed inorganic material leaves a very fine and effective capillary structure capable of adsorbing large quantities of gas at high concentrations.

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[1] Bulletin, 178-A, War Gas Investigations, Bureau of Mines.

[2] *Journal of Industrial and Engineering Chemistry*, 1919, 11, 420-467.

It is possible to demonstrate the correctness of the general principles outlined above. According to the theory, carbon deposited at low temperatures and absolutely free from hydrocarbons should be the purest form of active carbon, and should require no activating process. Carbon resulting from the reaction : $2\,CO = C + CO_2$, at 300° C., using ferric oxide as catalyst, proved to have an adsorptive capacity appreciably greater than the best samples of active carbon prepared from hydrocarbon sources. Again, it was possible to show that ordinary low-boiling hydrocarbons can exist in chars previously heated to 1000° C. or so for some hours, and this was done by distilling it in the presence of air at 300° C., when a product resembling anthracene was obtained. Summarizing what has been stated, it is held that active carbon is essentially a special form of pure amorphous carbon, deposited at low temperatures. It is free (1) from adsorbed stabilized hydrocarbons, which are normally associated with it and lessen its power of combining with other substances; and (2) from inactive carbon formed by gas-treating, that is, by the decomposition of hydrocarbons upon its surface at high temperatures. It is stated to be possible now to prepare intelligently this active carbon on a large scale from whatever sources of carboniferous material may be cheapest or most desirable for the particular purpose in view, and the unique properties of this material, both as catalyst and adsorbent, suggests that it will find many industrial applications.[1]

Use of Decolorizing Carbon ("Carboraffin") in the Double Polarization Method of Determining Sucrose. *V. Skola.* *Zeitschrift fur Zuckerindustrie in Böhmen, 1918, 469–474.*

When operating the double polarization method, it is often found that the liquid (especially that obtained after inversion) is too dark for accurate observation in the 200 mm. tube, so resort is had to *carbo animalis puriss.* or some other preparation. Decolorizing carbon offers good possibilities in this direction, owing to its very high power, and in order to examine the matter the following experiments were made. (1) Into a number of 100 c.c. flasks, 50 c.c. of a solution of sucrose were pipetted, and increasing amounts of "Carboraffin" decolorizing carbon were added to each of the series (excepting the control) the duration contract being 30–60 minutes. Whereas the polarization of the untreated solution was 49·25, the readings in the case of the contents of the flasks to which 0·1, 0·5, 1·0, 0·5, 1·0, and 5·0 grms. of the carbon had been added were respectively 49·13, 48·68, 48·75, and 44·135, indicating decreases of 0·12, 0·57, 0·50, and 5·115, due to absorption of sugar. It is therefore apparent that under the conditions of the experiment decolorizing cannot be used for the direct reading. (2) Into a series of 100 c.c. flasks, 50 c.c. of a solution of invert sugar were introduced, and decolorizing carbon added as before, the time of contract being 15–30 minutes. In these observations the control test gave 8·325, and those solutions treated with 0·1, 0·5, 1·0, and 5·0 grm. of the carbon read 8·315, 8·280, 8·145, and 7·575. It is therefore seen that in the case of a solution of invert sugar (containing acid) the adsorption occurring under the conditions specified is small, while it was shown to be somewhat less when the invert sugar solution was impure, as when it was prepared from beet molasses. It is therefore concluded that "Carboraffin" may advantageously be employed for decolorizing solutions used for the inversion reading in the double polarization method, provided that not more than 0·3 grm. be used, which quantity produces on the average an error of 0·03° V., or 0·06 per cent. calculated as sucrose by the Herzfeld formula. In order to utilize its decolorizing effect to the fullest extent, it is advisable to pass the liquid containing the carbon through a Buchner funnel using suction, returning the filtrate several times through the layer of carbon caught on the paper, a better result being thus obtained than simply by suspending the preparation for some time in the liquid.

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[1] It does not follow that a carbon having a great capacity of adsorbing gases will also be efficient in adsorbing colour and other impurities from their solutions, though some "activated" carbons may give very fair results. Examination has shown some "activated" carbons, stated to possess a particularly high power of adsorbing gases, to be practically useless for decolorizing purposes. In connexion with the study of decolorizing carbons, it seems worth while to recall the experiment made by the late T. L. Patterson with animal charcoal. He found (*J. Soc. Chem. Ind.*, 1903, 608) on extracting the finely ground material with sulphuric acid that a carbonaceous substance having a very high decolorizing power (40 times that of ordinary char) could be separated. It would seem of interest to repeat this experiment, in order to determine whether a similar body may be obtained from a high power decolorizing carbon.—Ed., *I.S.J.*

CLARIFICATION IN THE CANE FACTORY WITH PARTICULAR REFERENCE TO JUICE HEATERS, CONTINUOUS SETTLING TANKS, AND CENTRIFUGAL FILTRATION. *S. S. Peck. Report of the Committee on Manufacturing Machinery, 1919, Hawaiian Sugar Planters' Association, Honolulu.*

In the case of closed heaters (which have the advantages of being compact and of having a small steam consumption) the former standard of 30-40 sq. ft. of heating surface per ton of cane per hour does not appear to be sufficient when the vapours used come from a pre-evaporator installation. Although an average temperature of 212° F. is generally used in practice, it has been found that degrees of heat down to 190° F. will at times give better results. A temperature regulator has been found a very satisfactory attachment, as it controls the steam more faithfully than can be done by hand. A very important precaution, particularly where pre-evaporator vapour is used for juice heating, is a proper vent for the incondensible gases.

Continuous settling tanks are giving good service, and several installations of a type similar to that used by the Colonial Sugar Refining Co., of Australia, are projected for the next crop. In this form[1] a slowly revolving scraper removes the settled mud from the conical sides of the tank, directing it towards the opening at the bottom, where it is continuously discharged. It is, however, to be noted that the separation with such apparatus is not as distinct as in the older tyye of intermittent settling tanks; and that in order to avoid putting too much work on the filter-presses, re-settling of the muddy liquor discharged is necessary. Clarified juice from the settling tanks should be sent through 100-mesh screen before passing to the evaporators. Good work at lower cost can be obtained from flat screens placed below troughs from the settling tanks, as compared with a separate more elaborate piece of apparatus, such as the circular rotating screen. If they are situated so that the juice drops instead of flows upon them the accumulated "cush-cush" will be worked towards the further end, from which it can be removed from time to time with a wooden paddle by the attendant. Brushing should be avoided, as this tends to clog up the openings. The screens should be in frames which are easily removable so that they can be cleaned from time to time in a steam of water, and can also be easily replaced when broken.

Centrifugal clarification has much to recommend it, principally because of the quick transit of juice from heater to evaporator with little loss of heat that might be accomplished; but it has not been successful in operation so far. The irregular character of the impurities in the juice, the elimination of which depends on the proper addition of lime, demands a control to which centrifugal clarification does not lend itself.

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[1] See also *I.S.J.*, 1919, 246.

NEW TYPE OF INTERMEDIATE MILL CONVEYOR. *Wm. Locher. Report of Committee on Manufacturing Machinery, Hawaiian Sugar Planters' Association, 1919.*

During the past crop at the mill of the Hawaiian Commercial and Sugar Co., Maui, T.H., a new type of intermediate conveyor was installed between the first and the second and the second and third units of the train. No particulars of construction are given, but it is mentioned that the apparatus is a modification of the drag-slat type and was designed by Mr. R. E. HUGHES. It replaces the belt conveyor that has been in use at this factory during the past 10 years, and has proved satisfactory, its main advantages being stated to be as follows:—(1) cleanliness, as the dropping of bagasse and juice between the mills (which has increased since the introduction of grooving and shredding) is entirely prevented; (2) saving of time when changing rollers and making other repairs, as removal can be effected in one piece; (3) economy of upkeep, as no repairs or renewals were necessary in either of the two operated last season, whereas this was not so in the case of the belts: (4) no breaks due to choking of the mill occur, the moving parts being away from the rollers of the succeeding unit; (5) any sudden excess of dilution is prevented running upon the mill bed and floor, as it is taken up by the succeeding portions of the bagasse; and (6) as the apparatus forms a hopper, it not only aids the feeding of the mill, and provides for fluctuations in the flow of the bagasse, but also serves to give the blanket a thorough tumbling, bringing the more heavily saturated parts at the top and bottom into intimate contact with the comparatively dry centre, for a short time at least.

PREPARATION OF AN EDIBLE SYRUP FROM HOME-GROWN BEETS. *John M. Ort and James R. Withrow. Journal of Industrial and Engineering Chemistry*, 1920, *12*, No. 2, 154-156.

Sugar beets are easily grown, and a small plot would furnish the rural household with ample syrup for its use were it possible to prepare a product free from any unpalatable flavour: but although a great deal of work in different countries has been carried out with the purpose of overcoming this difficulty none proposed so far appears to have much practical value from the point of view under consideration. TOWNSEND and GORE [1] recently described "a simple process for making from sugar beets a palatable and nutritious table syrup with a pleasant flavour," a patent for which was taken out [2]; but many reports of failure from farmers when carefully following the prescribed directions have been received, improper topping of the roots being alleged to be the reason of these unsuccessful results. This matter has been taken up by the authors, who have conducted many tests to eliminate or destroy the undesirable flavour. Among these may be mentioned preliminary desiccation (atmospheric and vacuum) to coagulate the albumins; liming and carbonation; peeling, decoring, dialysis; and treatment with such substances as fuller's earth, tannic acid, bleaching powder, and animal charcoal (boneblack). Varying degrees of efficiency of clarification were secured in some of these experiments, but no marked improvement of flavour, though the use of kieselguhr seemed to have some effect in this direction at times. A cold water extract had the same obnoxious taste as a hot one, and the skimming of the boiling juice during concentration had little effect in realizing the desired object. It was, however, noticed that when the green shoulders of the beets were previously separated (by paring off) a good syrup was produced with only a *trace* of the disagreeable flavour, and even occasionally with none. Syrup made from these green portions possessed the undesirable flavour to a great extent; and was, moreover, very dark coloured. No thorough investigation of this point could be made on account of lack or material, but if this method were capable of giving consistent results, it would be a simple matter (the authors consider) to reduce the green portion by keeping the roots well covered with earth in the field. It was also noticed that the preliminary storage of beets improved the flavour, and it is suggested that the objectionable flavour is to some extent increased by working with immature roots. Further, kettles made of aluminium or enamel should be used for the concentration of the juice, it having been observed that copper gives a pronounced metallic after-taste to the syrup obtained.

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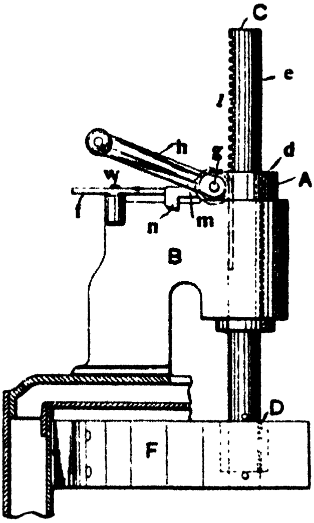
[1] *U.S. Dept. Agric., Farmers' Bulletin*, **823**, *I.S.J.*, 1919, 910. [2] *U.S. Patent*, 1,155,806.

Review of Recent Patents.[1]

UNITED STATES.

CENTRIFUGAL MACHINE DISCHARGER. *Edward D. Mackintosh (S. S. Hepworth Company, of New York, U.S.A.) 1,326,411.* Date of application, May 13th, 1919; patented, December 30th, 1919. (Two figures.)



Objects of this invention are: (1) to afford complete control of the discharger with one hand; and (2) to reduce the wear on the lining of the machine and on the scraper. Referring to the figure, it is seen that a sleeve *A* is journaled in a fixed bracket *B* to swing about a vertical axis. A rod *C* is moveable vertically in the sleeve and turns therewith because of a feather *D* fixed to the sleeve and extending into a spline *e* in the rod. Fixed to the end of the rod below the sleeve is a plough *f* adapted to guide the contents of the basket of the centrifugal machine from the wall to its central discharge opening. Then such contents are pushed against the plough by the rotation of the basket. The sleeve *A* is provided with arms, one of which *m*, has a lug *n* in contact with the bracket *B*, and the other of which bears against a latch with a tail piece *f* pivoted at *w*. This latch is kept normally in place by a spring, but when it is decided to swing the sleeve in order to remove the plough from the basket, pressure of the thumb on the tail piece *f* disengages the latch from engagement with the arm. To move the plough vertically in the basket the rod to which it is fixed is provided with teeth *l*, meshing with a penion *m*, and this pinion and hand crank are both fixed to a shaft *g*, journaled in bearings on the sleeve *A*. It will be noted that the only parts to be handled, in controlling every movement of the discharger, are the handle *h*, and the latch, and that the latter needs only a momentary touch with the thumb, while the hand retains its grip on the handle.

CARBONACEOUS DECOLORIZING AND FILTERING PREPARATION, CONTAINING KIESELGUHR. *Russell W. Mumford* (Assignor to *Refining Products Corporation*). *1,314,204.* Date of application, March 27th, 1918; patented, August 26th, 1919.

Kieselguhr is worked into a doughy mass with wet gas tar (the material still containing ammonia), or with gas liquor holding a certain amount of tar in suspension, the mixture obtained being slowly heated in a vented retort to a temperature of about 600° C. in the manner described in a previous specification.[2] A preparation is thus obtained which consists in the main of kieselguhr impregnated with carbon, since most of the tar enters the diatoms, either during the process of incorporation, or during the early stages of heating. Other tarry matter may be used, as wood tar or asphalt, but ammoniacal gas tar gives the best results, as it leaves a residue of nitrogenous carbon which is very active in decolorizing. In a modification of the process, the kieselguhr after being incorporated with the tar, is mixed with a certain amount, say an equal volume, of finely-divided brown coal or lignite, rich in volatile matter. This mass is formed into pellets and charred in the same way. The specification further states that kieselguhr and "carbonaceous material" may be mixed with a little milk-of-lime, or with a mixture of milk-of-lime and soluble phosphate, the excess of lime being removed finally by treatment with acid or by sedimentation.[1]

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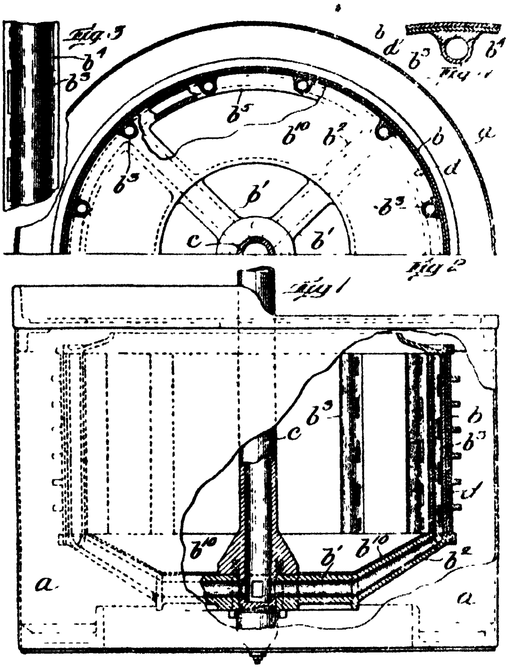
[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sale Branch, 25, Southampton Buildings, Chancery Lane, London, W.C. (price, 6d. each). *United States:* Commissioner of Patents, Washington, D C. (price 5 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 1 fr. 05 c. each).

[2] *I.S.J.*, 1919, 357; 1920, 116.

CENTRIFUGAL, THE CONTENTS OF WHICH ARE DISCHARGED BY MEANS OF COMPRESSED AIR, *Angus Gibson* (Assignor to the *Western States Machine Co.*, of Salt Lake City, Utah, U.S.A. *1,319,150*. Date of application, November 20th, 1918; patented, October 21st, 1919. (Four figures.)

Instead of discharging the sugar from the machine by means of ploughs or scrapers, pipes carrying compressed air are arranged close to the wall, and are provided with openings so placed that the mass is forced inwardly away from the basket. Referring to the figures, it is seen that the centrifugal basket *b* is of the usual type having a sloping bottom b^{10} provided with a central orifice to receive the supporting spider b' by which the basket is secured to the rotary suspension shaft *c*. Any suitable conduit may apply the compressed air to the air blast tubes, b^3, which are located at intervals around the inside of the vertical or peripheral basket. Preferably a slight space is left between the outer surface of the discharge tube b^3 and the wall of the basket *b* to allow the insertion of the usual lining or screen *d*. The vertical discharger tubes are connected by means of tubular arms b^2 with a perforated central spider b' whose interior passages are in communication with the centrally bored basket shaft *c* through which a suitable supply of compressed air is furnished to the individual discharger tubes. The radiating arms of the spider *b* are bored or of tubular form, so that the spider may perform the double function of connecting the basket to the basket shaft for proper support, beside affording conduits for the distribution of the air to the concentric discharger tubes b^3. As it is unnecessary to have a separate radial pipe leading to each discharger tube, an annular conduit b^5 is provided extending around the base of the basket to supply the intermediate discharger tubes with the requisite compressed air. The discharger vents b^4 for the air are preferably directed toward the lining *d* so as to bring the air blast between the mass of walled-up sugar and the lining in order that the disruptive action of the air on the sugar wall may be most effective. The supply of compressed air, which may be obtained from any convenient source, is admitted to the circuit *c* when the machine has been slowed down or stopped down altogether.



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[1] Compare also *I.S.J.*, 1920, 61, 114.

UNITED KINGDOM.

Unloading and Storing Cane Previous to Crushing. *Duncan Stewart & Co., Ltd., John S. Durham, and Thomas Wishart. 137,614 (1894).* Date of application, January 25th, 1919; complete accepted, January 22nd, 1920. (Three figures.)

Cane arriving at the factory in railway wagons, if not immediately required for the crushing plant is unloaded and stacked on the ground, which procedure necessitates double handling by crane or manual labour. If, alternatively, it is left in the wagons until required, it means that more rolling stock must be employed than otherwise would be necessary. According to the present invention, means are provided whereby the wagons may be promptly unloaded immediately they reach the factory, the cane being suspended in bundles in the air until it is required to be transferred to the mills. In certain known constructions in trolley cars, there is provided a beam to which are secured slings to carry the load, the beam being in turn secured to an overhead trolly. In order to render such apparatus particularly adaptable for handling cane, there are now provided means for detachably securing one end of the chain slings to the beam, and for automatically freeing the slings in turn when required to release the load of cane carried by the slings, as well as double shackle devices secured to the upper side of the beam to facilitate the raising of the beam and its connexion with an overhead trolley. Referring to the drawing, one end of each sling *D* is secured to the beam *E*, and the other end is slipped over a pivoted hook *G* which is held in the position shown, Fig. 3, by a pivoted finger *H*. A double shackle with eyes *K*, *L* at right-angles to each other is pivotally mounted at each end of the beam *E* and is provided with stops *K1* which bear against the beam and limit movement to a right-angle. A pair of trollies *Q* are connected by a rod *R* and have depending hooks *P*. When the slings *D* have been passed round a bundle of cane, each shackle *L* is engaged by the load hook *M* of a crane, and the beam *E*, with its load, is lifted until the shackles *K* can be engaged with the hooks *P*. The hooks *M* are then freed, and the crane is left suspended from the runway *C* until it is required to be transferred to the crushing-plant. A ramp *T* at the discharging point raises the finger *H* and releases the load.

FIG 3

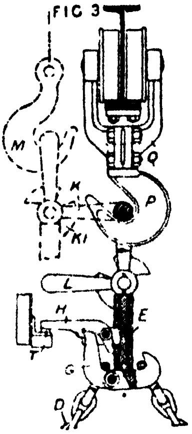
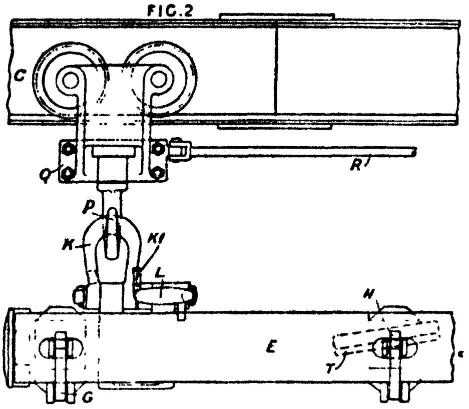


FIG.2



Centrifugal Pump. *Drysdale & Co., Ltd., John W. Drysdale, and John Young. 132,679. (19,317).* Date of application, November 30th, 1918; complete accepted, November 12th, 1919.

In a pump of the rotary tube type, the rotor comprises two chambers formed from the cylindrical cavity of the rotor by means of a diagonally-placed diaphragm. One chamber opens into the suction chamber on one side, and the other on the other side.

CENTRIFUGALS. *Robert S. Sturgeon.* (1) *130,128* (*11,818*). Date of application, July 19th, 1918; complete accepted, July 21st, 1919. (2) *Jean Schmidt.* *131,094* (*2393*). Date of application, August 10th, 1918; complete accepted, August 11th, 1919. (3) *Richard S. Brownlow.* *132,291* (*9555*). Date of application, June 11th, 1918; complete accepted, September 11th, 1919. (4) *Robert A. Sturgeon.* *134,158* (*6611*). Date of application, March 17th, 1919; complete accepted, October 30th, 1919. (5) *Robert A. Sturgeon.* *134,966* (*19,233*). Date of application, November 22nd, 1918; complete accepted, November 20th, 1919. (6) *C. A. Fesca & Sohn,* of Lichtenberg, Berlin, Germany. *137,827 (978)*. Date of application, January 12th, 1920; *not yet accepted.*

MOTOR SPIRIT CONTAINING ALCOHOL AND ETHER. *A. de feo Lopez,* of Buenos Aires. *133,434* (*16,398*). Date of application, October 8th, 1918; accepted.

A fuel for internal-combustion engines comprises alcohol partly etherealized, as by bubbling it through a mixture of alcohol and sulphuric acid at a temperature of from 100 to 150°C, mixed with from 10 to 40 per cent. of unetherealized alcohol and from 5 to 50 per cent. of a distilled hydrocarbon oil, the proportions being such as to give a mixture having a specific gravity of from 0·73 to 0·78.

MOTOR SPIRIT CONTAINING ALCOHOL. *United States Industrial Alcohol Co.,* of New York. *133,709* (*24,852*). Date of application, October 10th, 1919; accepted.

A fuel for internal-combustion engines consists of gasoline or other petroleum distillate, ethyl or other alcohol and carbon bisulphide, which serves to blend the whole together.

MOTOR SPIRIT CONTAINING ALCOHOL. *U.S. Industrial Alcohol Co.,* of New York. (1) *134,766* (*10,712*). Date of application, April 30th, 1919; *not yet accepted.* (2) *136,452 (11,177)*. Date of application, May 5th, 1919; *not yet accepted.*

It consists of petroleum distillate, such as gasolene, kerosene, or a mixture of these, ethyl or other alcohol and a fatty acid, such a linolic, or the acids from rape or linseed oil, or a compound containing the acid radical of an hydroxy-fatty acid, such as ricinoleic acid or castor oil, adapted to blend the alcohol and the petroleum distillate.

MOTOR SPIRIT CONTAINING ALCOHOL. *E. W. Stevens,* of Baltimore, U.S.A. *135,514* (*29,010*). Date of application, November 21st, 1919; *not yet accepted.*

The motor spirit consists of a burning oil, preferably kerosene, ethyl alcohol containing fusel oil or amyl alcohol, sulphuric or petroleum ether or "casing-head" gasolene, and toluol or crude benzol or heavier tar oils.

DENATURING ALCOHOL. *Alfred F. Joseph,* of London; *Wm. N. Rae and Claude T. Symons,* of Colombo. *129,904* (*19,095*). Date of application, November 21st, 1918; accepted, July 24th, 1919.

Essential oil or oils (such as citronella) with or without the addition of kerosene or paraffin oil or mineral naphtha is the mixture protected for denaturing alcohol.

MANUFACTURE OF MARMALADES, FRUIT JELLIES, ETC. *Eudo Monti.* *133,456* (*16,617*). Date of application, October 11th, 1918; accepted, October 13th, 1919.

In order that the finished product shall retain the perfume and flavour of the fruit from which it is prepared, the juice is concentrated by freezing and mixed with jelly made from such fruits as apples, quinces, currants, or gooseberries, or from agar-agar, by concentrating *in vacuo* at a low temperature.

GRINDING CHOCOLATE, ETC. *National Equipment Co.,* of Springfield, U.S.A. *133,476* (*17,182*). Date of application, October 21st, 1918; accepted, October 16th, 1919.

CLARIFICATION OF JUICES, AND THE PREPARATION OF A CATTLE FODDER. *M. von Wierusz-Kowalski*, of Liepzig, Germrny. *132,798 (22,774)*. Date of application, September 16th, 1919; *not yet accepted.*

Juice is heated to 80 to 100° C., treated with sulphurous acid "in the usual manner," and then (without reducing the temperature) with lime "until it has an alkalinity of 0·02 to 0·04," being finally filtered. The resulting product is said to contain a small percentage of inorganic substances than usually produced, and therefore more fit for use as food for animals.

UNITED KINGDOM COMPLETE SPECIFICATIONS ACCEPTED.[1]

INDICATING THE LEVEL OF LIQUIDS. *S. F. Barclay. 139,103 (19,148).* August 2nd, 1919.

MAKING DECOLORIZING CARBON *C. S. Hudson 139,156 (1846).* February 15th, 1919.

OBTAINING INULIN FROM PLANTS. *A. Daniel. 109,813 (13,418).* September 18th, 1917.

EVAPORATORS. *Akt.-Ges. Kummler & Matter. 123,716 (17,387).* February 26th, 1918.

WATER TUBE BOILERS. *Stirling Boiler Co. and H. J. S. Mackay. 139,426 (22,188).* September 9th, 1919.

FILTERING LIQUIDS. *F. K. & E. F. Atkins. 139,991 (17,059).* July 8th, 1919.

FILTER LEAVES. *A R. Peck. 139,390 (16,240).* October 22ud, 1918. (Divided application on 138,657).

ROTATING SCREEN FILTERING APPARATUS. *Dorr Company. 139,493 (5714).* October 5th, 1918.

WRAPPING CARAMELS. *F. Heath. 139,610 (5097).* March 1st, 1919

CUTTING MACHINERY FOR MARMALADE MANUFACTURE. *F. G. Blott and H. Friend. 139,653 (8554).* April 4th, 1919.

CONFECTIONERY. *L. Wirtz. 139,256 (1135).* January 16th, 1919.

COOLING CHAMBERS FOR CHOCOLATES, ETC. *Fours et Procédés Mathy. 139,383 (14,442).* June 6th, 1919.

HYDROMETERS. *P. D. Ivey and A. J Salisbury. 139,672 (10,067).* April 22nd, 1919.

FERTILIZER MANUFACTURE. *C. Rossi 130,963 (11,913).* August 9th, 1918.

FERTILIZERS. *Norsk Hydro-Elektrisk Kvaelstof-aktieselskab 132,496 (18,536).* September 13th, 1918. *139,462 (3990).* February 24th, 1919.

BEET, ETC., RAISING MACHINE. *H. Kimble and P. J. Beaumont. 139,723 (20,089).* August 15th, 1919.

BEET CUTTING MACHINE. *Naamlooze Vennotschap Machinefabriek De Pol. 130,592 (17,960).* July 30th, 1918.

SYNTHETIC MANUFACTURE OF EYTHL ALCOHOL AND EYTHL ACETATE. *P. V. H. Pascal. 140,115 (9019).* April 3rd, 1917. *140,527 (224).* January 16th, 1918.

DESSICATION OF POTATOES AND THE LIKE. *Soc. Wauquier et Cie. 122,422 (1083).* January 15th, 1918.

MACHINES FOR COATING WITH CHOCOLATE. *P. Norwood. 140,283 (14,966).* June 13th, 1919. (Cognate application, 24,739/19).

MANUFACTURE OF COCOA POWDER. *L. Alberts. 140,703 (22,429).* September 12th, 1919.

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[1] The date given is that of application.

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

	One Month ending March 31st.		Three Months ending March 31st.	
	1919. Tons.	1920. Tons.	1919. Tons.	1920. Tons.
Unrefined Sugars.				
Russia	....	....	....	....
Germany	....	800	....	800
Netherlands	1	....	1	....
Belgium	....	....	....	....
France	....	....	....	....
Austria-Hungary	....	....	..	....
Java	36,119	14	43,418	162
Philippine Islands	....	....	....	....
Cuba	49,889	48,362	100,091	123,681
Dutch Guiana	34	....	961	....
Hayti and San Domingo	....	....	....	....
Mexico	....	....	....	....
Peru	2,698	4,094	15,314	16,579
Brazil	....	1,109	....	5,134
Mauritius	12,232	24,247	47,517	79,538
British India	....	100	....	1,486
Straits Settlements	....	....	....	....
British West Indies, British Guiana & British Honduras	1,342	5,136	3,106	15,347
Other Countries	282	7,546	294	12,152
Total Raw Sugars	**102,596**	**91,408**	**210,702**	**254,879**
Refined Sugars.				
Russia	....	....	....	....
Germany	....	....	....	125
Netherlands	....	2	....	983
Belgium	....	209	....	502
France	....	....	16	2
Austria-Hungary	1	....	....	19
Java	9,288	..	12,820	7,420
United States of America	17,180	12,055	43,908	56,477
Argentine Republic	....	3	6	5
Mauritius	5,438	....	5,439	....
Other Countries	99	95	237	6,836
Total Refined Sugars	**32,006**	**12,364**	**62,426**	**72,369**
Molasses	16,843	18,526	33,486	32,081
Total Imports	**151,445**	**122,298**	**306,614**	**359,829**

EXPORTS.

	Tons.	Tons.	Tons.	Tons.
British Refined Sugars.				
Denmark	....	....	....	2
Netherlands	....	....	....	....
Portugal, Azores, and Madeira	....	....	....	....
Italy	....	....	....	....
Canada	....	....	....	....
Other Countries	95	37	298	94
	95	37	298	96
Foreign & Colonial Sugars.				
Refined and Candy	101	144	132	476
Unrefined	12	4	69	1,232
Various Mixed in Bond	....	....	....	....
Molasses	6	351	16	829
Total Exports	**214**	**536**	**515**	**2,633**

Weights calculated to the nearest ton.

United States.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1920. Tons.	1919. Tons.
Total Receipts January 1st to April 1st	858,642	701,979
Deliveries ,, ,,	857,055	701,979
Importers' Stocks, February 18th	—	—
Total Stocks, April 1st	94,074	66,469
Stocks in Cuba, March 27th	580,122	728,075
	1919.	1918.
Total Consumption for twelve months	4,067,671	3,495,606

Beet Crops of Europe.

(Willett & Gray's Estimates to April 1st, 1920.)

	Harvesting Period.	1919-20. Tons.	1918-19. Tons.	1917-18. Tons.
Germany	Sept.-Jan.	750,000	1,411,900	1,541,061
Czecho-Slovakia, Hungary and Austria	Sept.-Jan.	600,000	700,000	668,250
France	Sept.-Jan.	155,000	110,096	200,265
Belgium	Sept -Jan.	125,000	75,000	131,000
Holland	Sept.-Jan.	230,000	173,436	199,295
Russia (Ukraine, Poland, etc.)	Sept.-Jan.	350,000	700,000	1,028,580
Sweden	Sept.-Jan.	150,000	127,467	125,000
Denmark	Sept.-Jan.	160,000	144,600	136,800
Italy	Sept.-Jan	150,000	100,000	100,000
Spain	Sept.-Jan.	120,000	135,000	134,955
Switzerland	Sept.-Jan.	4,000	4,000	4,000
Bulgaria	Sept.-Jan.	15,000	16,000	22,000
		2,809,000	3,697,499	4,291,206

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR THREE MONTHS ENDING MARCH 31ST, 1913, 1919, 1920.

	IMPORTS.			EXPORTS (Foreign).		
	1913. Tons.	1919. Tons.	1920. Tons.	1913. Tons.	1919. Tons.	1920. Tons.
Refined	182,284	62,426	72,369	324	132	476
Raw	225,772	210,702	254,879	789	69	1,232
Molasses	37,154	33,486	32,081	75	16	829
	445,210	306,614	359,329	1,188	217	2,537

	HOME CONSUMPTION.		
	1913. Tons.	1919. Tons.	1920. Tons.
Refined	173,602	50,420	72,606
Refined (in Bond) in the United Kingdom	167,264	197,777	161,368
Raw	24,129	70,153	98,120
Molasses	7,309	9,911	11,594
Molasses, manufactured (in Bond) in United Kingdom	9,876	19,336	20,211
Total	382,180	347,597	363,899
Less Exports of British Refined	6,386	298	96
	375,794	347,299	363,803

Sugar Market Report.

Our last Report was dated 9th March, 1920.

The Royal Commission's price of 66s. per cwt. duty-paid for granulated Crushed and White pieces, delivered for domestic consumption, has been raised to 80s. Jam Manufacturers, who have hitherto been supplied at the same rates, have now to pay the price charged to other manufacturers, viz., 114s. Concurrently with these alterations, the maximum price for "free" sugar has been reduced from 120s. to 114s. Although the demand for white descriptions of "free" sugar has been but moderate, the quantity remaining for sale is almost negligible. and some holders have withdrawn from the market in anticipation that a higher "reasonable maximum" price will be fixed at the next regulation of values by the Royal Commission. West India Crystallized and Syrups ("free" Sugar) have been neglected for many weeks past, but advancing markets abroad have stimulated some enquiry, and a fair day-to-day business is now passing at improving rates.

The notable feature of the market at the moment is the remarkable advance in the quotation for Cuban sugars. The movement appears to have been initiated by an active demand from American distributors and manufacturers desiring freely to contract White Sugars for summer and autumn requirements. To cover this demand, refiners have to purchase corresponding raws, mainly of course from Cuba, and the quotation, which stood at 9·75 cents to 10·00 cents f.o b. at the date of our last Report, advanced steadily to 11·25 cents. Fresh impetus was given to the advance by the publication of Messrs. Willett & Gray's reduced crop estimate of 4,000,000 tons, and the later announcement by Messrs. Guma & Mejer that their preliminary calculation of 4,436,000 tons had been amended to 3,900,000 tons; prices have been rushed up with great rapidity, to-day's quotation standing at 16·00 cents f.o.b., or about 90s. per cwt. at the present rate of exchange. It is reported that extensive cane fires, and, more particularly, a somewhat prolonged period of drought, have affected the weight of production, both actual and prospective.

The Java market is almost entirely in the hands of speculative operators, mostly Chinese and Japanese firms, who purchased new crop sugars some months ago at a comparatively low level of prices. Values have moved very irregularly, direct sales to India being occasionally reported at several shillings per cwt. below current general quotations, this anomaly being due to special considerations of particular sellers and the vagaries of exchange. Business was reported a few days ago in White Javas c.i.f. U.S.A. ports, July-August shipment at 85s. per cwt., but advices to hand to-day announce similar transactions at 95s. The market is excited by the Cuban advance and the enquiry from America. Latest f.o.b. quotations by cable are nominally :—Old crop, April-May shipment, 48·50 guilders per picul (of 136 lbs.), say 82s. per cwt.; July, 47·00 guilders, say 79s. per cwt.; August-September, 46·00 guilders, say 77s. per cwt., but it is noteworthy that the last price paid by the U.S. is much above these parities.

Recent Continental advices do not support the expectation hitherto entertained, that a substantial increase of sowings might relieve the situation in the late autumn and onwards. French estimates speak of a probable crop of 250,000 tons, or an increase of some 70,000 tons. Official advices from Czecho-Slovakia state that the acreage to be sown will suffer considerable diminution, because in spite of favourable prices, the difficulties of labour and the lack of transport facilities are such as to discourage beet growing. The hope is expressed, however, that the disadvantages of reduced acreage will be compensated to some extent by improved yield, since large quantities of artificial manure have been imported, which should bring relief to the exhausted soil.

Mr. F. O. Licht, of Magdeburg, in reviewing the outlook for Germany, complains that the operation of Government control is so inconsistent that a deterring effect is produced upon cultivation, in spite of improved labour conditions in some districts. In Rhineland, Bavaria, parts of Macklenburg and Saxony, sowings may be increased by 30 per cent. or more; on the other hand, in Hanover, Brunswick, Pomerania and other parts of Saxony no important extension, but rather a further reduction must be expected. He considers that an average increase of 10 per cent. over last year's sowings must be looked upon as a maximum figure. Mr. Licht proceeds as follows :—"A moderate view of the possibilities of production for the coming year shows that, even an increase in sowings of 50 per cent. upon the present small production, would scarcely satisfy in full measure the inland requirements."

H. H. Hancock & Co.

10 & 11, Mincing Lane,
London, E.C. 3,
April 12th, 1920.

THE

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☞ The Editors are not responsible for statements or opinions contained in article which are signed, or the source of which is named.

The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

Notes and Comments.

The 1920 Budget.

It must be a good many years since there was no mention of sugar in the British Budget, for this commodity has been the subject of varying taxation—or of political apologetics—every year since pre-war days. But for once this year the Chancellor of the Exchequer (Mr. AUSTEN. CHAMBERLAIN) had no occasion to refer to the sugar tax, which remains unchanged; there is however a rise in the duty on rum in keeping with the decision to raise the duty on spirits. Rum hitherto taxed at £2 12s. 10d. per proof gallon with an Imperial preference of 2s. 6d., is now to bear a duty of £3 15s. 4d. with the same preference for our colonies. Another rise is in the postal charges, which are to be increased, ostensibly to provide the wherewithal to pay greatly increased wages to post office employees. The letter post is to be raised to 2d. while it is intended before long to raise also the rates of book packet postage, which means that the cost of posting publications such as ours all over the world will be still further increased. A welcome feature is that at length some concession is to be made to income tax payers who have businesses in the colonies which are also locally liable to income tax on their profits—a position which has hitherto involved their income being twice taxed.

Fifty years ago in 1870 our predecessor, the *Sugar Cane*, in discussing the then Budget wrote that "it is long since any Chancellor of the Exchequer had a surplus at his disposal of over four millions sterling, and very rarely has the disposal of it given such widespread and general satisfaction. A reduction of 50 per cent. on the sugar duties is not merely a boon to the English customer . . ." Actually the duty was reduced to 6s. per cwt. on refined as compared with 25s. 8d. at the present day. As regards the surplus referred to, it is diverting to compare it with the estimated surplus that the present year's taxation is expected by the Treasury to achieve, viz., £234,198,000 or more than 58 times the surplus of 1870! The estimated revenue for the 1920-21 fiscal year is expected to be £1,418,300,000, a truly prodigious sum to raise; but as £220,000,000 of it is to be derived from the extremely unpopular excess profits tax, it may be assumed that this total is not likely to remain a normal post-war annual revenue. It is rather an attempt to wipe out a slice of the national debt at the start before trade has settled down to normal competition and normal profits.

Kelham.

We understand that the necessary £125,000 required from the public for financing the Kelham beet factory has been subscribed, so that aspect of the scheme has been satisfactorily settled. Work has now begun on the erection of the buildings, and the contract for the plant and machinery has been placed with the well-known French firm of Fives-Lille. This granting of the order to a foreign firm has roused some ire on the part of British firms, and on the strength of the Government's connexion with the enterprise, questions have been asked in the House of Commons, and a deputation from the British Empire Sugar Machinery Manufacturers Association has waited on the Ministry of Agriculture to ask for an explanation of the action of the Kelham promoters in placing the contract abroad instead of with a British engineering firm.

The Government's answer is in effect that the directors of Home Grown Sugar Ltd. must be allowed to manage their business as they think best; but it was stated that the contract was only placed after consideration of competitive tenders of which the French one was the lowest, and that though the contract was duly advertised in the press, the response from British firms was disappointing both as regards number and character; so after taking expert advice the order was given to the Compagnie de Fives-Lille. It had, however, been arranged that British firms who specialized in specific parts of the machinery should have the opportunity of acting as sub-contractors for those parts.

Sentiment apart, it must be conceded that the directors were within their rights in buying in the cheapest market, if indeed it was the case that the French tender was the lowest (and the rate of exchange between France and England would certainly be an aid to the French firm). But that seems to us to be their sole justification. On all other counts we think they should have hesitated to take a step which invalidated the all-British character of this experimental beet sugar factory. It is alleged that they stipulated in their advertisement of the contract that the contracting firm must have experience in the making of beet sugar machinery—a condition which would certainly rule out most British sugar machinery firms, for the substantial reason that they have never had much chance (thanks largely to tariff systems in foreign countries) of making specific beet sugar plants. This if true would account for the meagre response to the advertisement. On the other hand, since about 80 per cent. of the plant of a beet sugar factory is practically identical with that of a cane sugar factory, it cannot be said for a moment that British firms were unable to turn out efficiently at least that 80 per cent. At the very least that portion of the machinery ought on national grounds to have been ordered from a British firm. It is also alleged that the Fives-Lille firm have placed orders in Prague and Amsterdam for some of the machinery, which if true would not even leave the plant for this factory a purely French production. Whatever be the actual facts, it is regrettable in the extreme that the directors of the first beet sugar factory to be planned by an all-British management should feel bound to pass by the products of their own country and place their orders abroad. They have by their persistent propaganda in the press made a national affair of it, and there is less excuse, therefore, for resorting to foreign machinery for the factory equipment.

The Australian Sugar Commission's Report.

Mail advices just to hand from Queensland state that the Report of the Royal Commission on the Sugar Industry was presented to the Commonwealth Parliament on March 19th. The following is a brief summary of some of the principal points and recommendations.

The Report states that the value of sugar land in New South Wales and Queensland was £5,541,486, and the capital invested in raw sugar mills and machinery £4,500,000. In Queensland the industry employs 14,500 persons, apart from those working in the sugar mills. Besides these, 1,550 coloured aliens have obtained permits from the Agricultural Department to work in the sugar industry in Queensland. A representative of the Australian Workers' Union made strong objections to the Committee as to the extent to which foreigners, particularly Italians, were taking up cane growing in North Queensland. It was alleged that the Italians evaded the wages awards; but the Commission found that no systematic evasion occurred. It appears however from evidence given that the Italians are making a permanent home in the sugar districts and the opinion is expressed that they are and will be a valuable asset to the industry.

In the matter of wages paid and work done, the Report states that a cane cutter cutting four tons per day could earn £1 daily. The average tonnage was however variously estimated at from three to six or seven tons daily. The average price paid by the sugar mills per ton of cane for the 1917-18 season was £1 12s. 6½d. The highest price was paid by the Colonial Sugar Refining Company's mills, this being £1 14s. 7d.; while the lowest average was to the credit of the Government central mills which averaged £1 10s. 7d.

In considering the beet sugar industry, the Commission arrived at the opinion that there was no substantial indication that in the near future any important extension of beet sugar manufacture would take place in Australia, or that there was any present necessity from the Commonwealth point of view to suggest any special measures relating to the production of beet sugar.

The appointment was recommended of a Commonwealth Sugar Control Board consisting of three Commissioners, whose headquarters should be in Queensland. It was also recommended that a thorough investigation should be made into managing and refining costs before any new arrangement be entered into with the refining companies.

A Proposed Cuban Sales Combine.

Before the war, Cuban sugar manufacturers were greatly at the mercy of purchasing interests in the United States and elsewhere, largely because they had no selling organization and no adequate storage facilities. The consequence was they had to sell just when their sugar was turned out, and consequently the price received by the Cuban producer was as a rule considerably less than the average world's prices; this was inevitable when a large number of producers were simultaneously clamouring to sell to a smaller number of purchasers. But the war has changed all that, and put the Cuban producer in a much stronger position. Storage facilities while not yet fully equal to the demands are much better, and there is not the same hurry to realize.

In the hope of strengthening their position still further, the Cuban producers recently (according to *Facts about Sugar*) appointed a committee to consider and recommend measures for assuring to producers a reasonably full measure of the actual market value of their products; and this committee has just issued its report. This declares that the principal reason for the offering of sugar by hacendados, even at a time when the market is weak, is the necessity of obtaining funds with which to pay colonos for the canes. The committee believes that with a production of four million or more tons of sugar per annum the difficulties faced

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[1] It may be added that since the Commission reported a number of arrangements have been entered into between the parties concerned, particulars of which we hope to record in a later issue.

by Cuba in the sale of its crop will each year become greater. It holds, however, that as Cuba is the largest sugar producing nation, it should logically have some share in fixing the world's price of sugar. It believes that there is only one true remedy for prevailing conditions and that this consists in making the sale of the entire sugar crop through the agency of a single sales organization.

Accordingly, the committee recommend that a selling committee be constituted, composed of members selected from the Association of Hacendados and Colonos, with offices both in Havana and New York. It is not proposed to dispense with the services of the usual brokers in Havana and New York, but these latter would have to deal with the selling committee and not with individual hacendados. The selling committee would have full power to decide the price at which any given sugar was to be sold, this price obviously depending on the conditions of supply and demand. They would also control all export of sugars, no hacendado being allowed to sell sugars for abroad.

The report adds that no plan of this nature would be complete unless backed up by financial resources. It recommends that the work of the Association's Bank already formed shall be extended, by interested parties subscribing for shares in this institution to the extent of, say, 20 cents per bag of sugar made by each hacendado and 20 cents for each 250 arrobas of cane ground by each colono, and that if these subscriptions are forthcoming the bank begin its existence at once for the purpose of assisting in defending the sugar industry of Cuba. It is planned that the bank should establish a storage warehouse, and this would be a factor in rendering easier the obtaining from other banks of funds based upon the stored sugar.

The report has still to be adopted by the Association, before anything is done on the lines recommended. But, as our American Correspondent points out elsewhere, conditions have of late been so strongly in favour of the Cuban producer that the proposal may never need to be put into operation, although the fact that it was approved by a representative gathering of Cuban mill operators and planters shows that its adoption could be realized if at any time the need was emphasized.

Trade Conditions and Prospects in the British West Indies.

H.M. Trade Commissioner in the West Indies in the course of a report[1] on trade conditions and prospects in our colonies, remarks that it may be safely said that the planters of these islands since the signing of the Armistice have been experiencing a tide of prosperity little known to most of them for very many years. This has been due to the great rise in the value of the staple products—sugar, rum, refined molasses (from Barbados and St. Vincent), cocoa, coconuts, bananas, coffee, etc. But much hardship has been experienced by the labouring classes during this period as, while wages tended to remain stationary, the prices of imported foodstuffs rose about 100 per cent.

The sugar industry, including the distilling of rum and the making of molasses, etc., may be said to be the chief industry on which these Colonies depend, and never before have conditions been so favourable for the Colonies engaged therein. The result has been that several islands, that previous to the war had turned their attention to other industries, have found it profitable to revert once more to the producing of sugar, etc. The principal Colonies engaged in sugar are British Guiana, Trinidad, Barbados, St. Kitts-Nevis, Antigua, and Jamaica.

During the period November, 1918 to November, 1919, labour supply in the West Indies may be said to have been satisfactory in the small islands, but the larger Colonies, e.g., Jamaica, Trinidad, and British Guiana, suffered in a greater or lesser degree from this cause. In Jamaica difficulties in the labour supply were experienced because of the increased exodus of labourers to work on the sugar plantations in Cuba, and to some extent because, on the return of former labourers who had joined the British West Indies Regiment, they were unwilling to go back to their former means of livelihood.

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[1] Published in the *Board of Trade Journal*.

There has been, unfortunately, considerable labour unrest combined with racial propaganda in many of the Colonies; and in Trinidad, in order to cope with this, a very important step has been taken by the appointment of a Wages Committee to enquire into and report upon the rates of wages paid to labour in the Colony, and to examine into the economic position of the various classes of workers with a view to recommending wages suited to the present conditions. An Ordinance has also been passed by the Legislative Council of Trinidad making provision for the settlement of differences between employers and workmen, and temporarily to restrict the promotion or organization of strikes and lock-outs pending the submission of the report of the Wages Committee. The appointment of this Wages Committee is a piece of bold constructive policy, and its findings should prove of great service, not only to the worker and employer in particular, but to the whole Colony in general.

Trinidad and British Guiana largely depended in the past for their supplies of of labour on East Indian immigration. Since the stoppage of this by the Indian Government, these Colonies have been experiencing difficulties in their labour supplies and are now endeavouring to remedy the consequent shortage. This shortage of labour was much more serious in British Guiana, with the result that a deputation was despatched to the United Kingdom to wait on Viscount Milner, and then proceed to India to place their views before the Indian Government, and if possible to devise a scheme whereby East Indians might be encouraged to settle in that Colony.

The Natal Sugar Industry: Some Data.

The Natal Sugar Association not long since issued a memorandum giving data of the cost of production in the Natal sugar industry, from which we take the following points. From 15,000 to 20,000 Europeans on the Natal coast are directly or indirectly dependent on the sugar industry. Production which now has an annual output of £3,000,000 has increased threefold during the ten years 1908-09 to 1918-19. Now that Imperial Preference has recently been granted by the Home Government, the Natal producers feel assured that they will be able to compete in the world's markets, and they are looking to the Union Government to assist them to this end.

As some indication of the increased costs now to be borne by the industry, it is pointed out that a mill capable of producing 15,000 tons of sugar in the one season, which before the war would have cost say £215,000, would to day cost more like £450,000. Existing mills have had to carry on as best they could during the war period, replacements having been unobtainable, so now the owners are faced with the prospect of enormous capital expenditure. An investigating commission has reported that the average profit realized per ton of sugar manufactured for five consecutive seasons (1914 to 1918) was £4 11s. At this rate the return on the capital of approximately £6,000,000 invested in the industry works out at 7·23 per cent. per annum. So far as the mills are concerned, this profit was earned on the pre-war cost of erection estimated at £14 per ton of sugar capacity, whereas present costs of erection are about £30 per ton. The return on capital invested in new mills would thus be reduced to 3·37 per cent., a rate which would never attract capital.

These data, we may add, were put forward in connexion with the agitation on the part of the sugar industry for a cessation of the Government control of the price of sugar, and they certainly justify the producers in their claim for a larger return at the cost of the consumer, who in South Africa has for some little time past been unduly favoured as compared with consumers in other countries. Thanks to controlled low prices, the South African consumer is said to have saved over £5,000,000 in one season in his outlay on sugar.

A German View of the Sugar Situation.

The *American Sugar Bulletin* draws attention to a pamphlet issued by the German Foreign Office in which is an article on "The Fight between Beet and Cane Sugar" by Dr. T. ZELLER, who comes to the following conclusions: "Germany has lost 75 per cent. of her producing capacity for sugar, since last campaign she only produced 741,847 tons against 2,718,000 tons in 1913-14. In addition she has lost through the Peace Treaty an important sugar province. If, however, the smaller German Empire can bring its sugar production up again to its pre-war level it would be in a position to deliver 2,330,000 tons. But there are great difficulties in the way, viz: the labour question, shortage of draft animals, and, particularly, of artificial fertilizers and fuel for the factories. It must therefore be sought to overcome these difficulties, for the reconstruction of the sugar industry is of fundamental importance to the whole social fabric of Germany. The German farmer knows that on good soil, no other product, in comparison to its size, yields so much albumen and starch as the beet, and that its cultivation appreciably increases the yield of crops, particularly wheat, sown after it. Moreover, almost alone, the sugar industry is practically independent of foreign aid, and without the use of foreign raw materials is in position to produce a valuable article for export.

"The depreciated exchange provides a 'ready-made' method of competing with every class of foreign sugar in the World's market. To day one ton of sugar f.o.b. Cuba costs $200 or 20,000 marks. The new selling price in Germany is 3000 marks, a difference of 17,000 marks. The farmer can therefore profit to an extent impossible at home. The German nation would have at its disposal through the export of sugar a large credit abroad. Assuming the production of 2,330,000 tons, and for home consumption 22 kg. per head per annum or 1,330,000 tons, they should have one million tons for export. For this they should receive 20 milliards of marks or in English currency (£1 @ M. 340) 59 million pounds sterling.

"No other German industry is in a position to procure so large an amount of foreign credit without help. That their sugar would not find a market is not to be feared considering the information respecting possibilities of production. If they appeared in the World's market with large quantities their exchange would benefit. But the improvement would not occur at such a rate as to prevent their ultimately reaching their goal. The export of sugar is by far the best way of ensuring purchases abroad. It is necessary however to act quickly. They must reach the goal before Russia is in a position to dump large quantities into the world's market. Germany's task in the battle between beet and cane is to be the champion of European beet sugar."

Notes on American Sugar Production.

From our American Correspondent.

Not within the memory of the oldest member of the sugar trade have conditions like those of the past two months existed in the American sugar market During the height of the Cuban crushing campaign, the period when the prices of raw sugar usually reach the lowest levels of the entire year, quotations in the New York market have advanced with a rapidity and violence never before witnessed.

A month ago 96° test Cuban centrifugals were selling at 10½ cents per lb. (5¼d.) c. and f., New York, equivalent to slightly over 11½ cents (5¾d.) duty landed. To-day the same grade of sugar commands 18 cents (9d.) and so excited is the market that no one ventures to predict when the apex of the rise will be reached or what heights it will attain. Truly, we are witnessing that oft-mentioned but seldom seen phenomenon, a runaway sugar market.

Two factors have contributed powerfully to the swift advance of the last few weeks. One of these is the general agreement of statistical authorities that the actual production realized from the current Cuban campaign will be much below early estimates. Based upon the output of those mills which have concluded grinding and upon observations of the effect of dry weather upon the crop, it is now generally admitted that the total Cuban crop will be less than that of last year and that it will fall short by probably 500,000 tons of the early estimates of approximately 4,400,000.

The second factor in driving prices upward is the persistent and apparently insatiable demand for sugar by American consumers which thus far shows no sign of slackening under the influence of rising prices. It must be remembered that many interior markets have been unable to replenish stocks since the shortage of last Autumn. Becoming alarmed at their inability to obtain supplies at a season when they usually are most abundant, household consumers and manufacturers of products requiring sugar have alike taken alarm and are striving frantically to obtain sugar at any price.

So swift has been the advance in the prices of raw sugars that we now have the anomaly of 96° test centrifugals selling at 2 to 3 cents above the wholesale quotations for fine granulated. The explanation is of course that refiners are still working on raws purchased at much lower levels. To a degree, however, present quotations for refined are merely nominal as several large refiners are withdrawn from the market and others are alloting their output closely to their regular trade. A readjustment of quotations to bring the price of refined into line with that of raws must soon take place. When this readjustment is made, sugar will be selling at the highest price it has reached in this market for more than fifty years. An appreciable decline in consumption should be the logical result, but it must be admitted that no indications of any such development are yet in evidence.

Last month we commented upon the fact that the policy adopted by American refiners of purchasing only to meet current requirements (which policy was designed to drive down the price of Cuban centrifugals) had placed control of the situation in the hands of Cuban sellers. Since then the latter have given new and convincing proofs of their solidarity and their ability to withhold their sugars from the markets at times when prices are not to their liking. A meeting of the Association of Hacendados and Colonos of Cuba, held on March 20th, not only confirmed this policy but went further and approved a plan for the sale of the entire Cuban sugar crop through a single sales agency. Conditions have been so strongly in favour of the Cuban producer that there has been no occasion for putting this proposal into effect this season and there are not lacking predictions that it never will be carried out, but the fact that the proposal was approved by a representative gathering of Cuban mill operators and planters indicates that its adoption is by no means impossible of realization.

The logical effect of present high prices should be a decided stimulation of sugar production within the United States for the coming year. Present indications are that some increase in the output of domestic sugar for the season of 1920-21 will take place but that this will be far from adequate to meet the tremendously increased demands of the American market.

Reports from Louisiana both as to the acreage carried over from last fall and the extent of spring plantings indicate a material increase over last year's short crop. With favourable growing conditions the Louisiana output may reach 300,000 tons as compared with less than half this amount for the past season. So many uncertainties attend the making of the Louisiana crop, however, that any prediction as to final production at this season can be nothing more than a guess.

In the beet sugar industry the high prices demanded by growers of beetroots and the acute shortage of farm labour are operating to restrict acreage. The present outlook is for the sowing of an area slightly larger than last year's, which should result under favourable conditions of temperature and rainfall in a production of over 900,000 short tons of sugar, or about 150,000 tons above last season.

Hawaii and Porto Rico have so fully developed their limited areas adapted to cane growing that no great increase in their production can be anticipated. Variations in their output from season to season are influenced chiefly by growing conditions. If their combined production in 1920-21 equals that estimated for the current season—slightly over 1,000,000 short tons—the result will be considered as satisfactory as may reasonably be anticipated.

The one section of United States territory in which the cane sugar industry is expanding most rapidly at present is the Philippines. During the past two years a relatively small proportion of the Philippine crop has come to this market, most of it having been sold in the Far East. The continuance of very high prices may attract more Philippine sugar here, but this again is a possibility dependent upon conditions that cannot now be foreseen.

There is little ground for expectation, therefore, that the production of sugar within the United States and its insular possessions will show an increase greater than 300,000 tons next season, aside from any additional amount that may be drawn from the Philippines. Cuba apparently must still be relied upon to supply more than half the total requirements of American consumers. Cuban producers undoubtedly will make a tremendous effort to bring forward next year a larger crop than they have ever before produced but, as the experience of the present season illustrates, apparently slight factors may cause a variation of as much as half a million tons in the final outturn of a crop so vast as that of Cuba has grown to be. The utmost efforts of sugar producers in Cuba and the United States seem likely to accomplish little more than to keep pace with the steady growth in the demand for sugar on this side of the Atlantic. Relief for the world's sugar shortage apparently must come, therefore, from other quarters, as to which the outlook, according to reports received here, is far from encouraging.

New York, April 14th, 1920.

Agricultural Notes.

The origin of the sugar cane.—Tracing the passage of any cultivated plant from its wild conditions is always a fascinating amusement. Language, history, botany, all three lines have to be carefully followed out, and it is only by the convergence of the three that any certainty can be attained, especially when the cultivated form is no longer directly traceable to any wild ancestor. In the case of the sugar cane, all three of these lines are available in south-eastern Asia, and the result arrived at is that the sugar cane is thought to have arisen from a wild grass, widely spread over India and the parts of Asia east of it and extending over some of the islands of the Pacific. The presence of a very ancient language and literature in India has perhaps somewhat obscured the claims of oceanic islands which have none of these advantages. As to whether the Pacific Islands have a right to be considered as a home of the original plant from which the cultivated sugar canes have arisen, this must be left to the last named line of study, namely that of botany.

Saccharum spontaneum is the only wild species in the genus which has close botanical relations with the sugar cane, which is named botanically *Saccharum officinarum.* It is found in every part of India and shows itself remarkably sensitive in its varieties to the moisture of the locality. Thus in the Punjab it is a small wiry grass which causes considerable trouble in the fields; this form extends as far as the Central Provinces, but further south it is confined to wet places, ditches and river banks, and shows no inclination to become thicker and more cane-like in the tropical conditions of the Madras Presidency. In Bengal, Assam and Burma, however, where the air is moister, a number of thicker forms are found with broader leaves, some of which, such as that met with in the ponds around Dacca, show a close approximation to the more primitive groups of indigenous Indian canes. The botanical evidence therefore suggests that the transition from the wild to the cultivated form may be most reasonably sought less in the tropical parts of India than around the north of the Bay of Bengal, and this is the view usually held. Even in the Punjab, where the wild cane is a field weed, the cultivator points to it as the ancestor of the sugar cane, and there is some evidence that in former times the thicker Bengal form was occasionally crushed, on the banks of the Hooghly, for its half-sweet juice.

But the fact must not be lost sight of that there are a number of distinct groups among Indian sugar canes, and it is only in the primitive Saretha series that this line of derivation is clearly seen. Many of the members of this group show marked resemblances to the wild *Saccharum spontaneum.* The varieties differ a great deal among themselves and, starting with primitive forms in the Punjab, extend east and south, ever increasing in size as they approach more congenial conditions of climate. The Sunnabile group, with a similar distribution, show some evidence of being derived from the same source, in that its most primitive forms in the Punjab are with some difficulty distinguished from the smaller Saretha varieties. But the connexion between these two groups and the Mungo, Nargori and Pansahi are obscure, and if they are to be traced also to *Saccharum spontaneum* one can only suggest that, at some former time, the whole species passed through a mutational period whereby a series of new forms were developed which have served as the starting points for these three groups. They are among themselves much more homogenous, and as distinguished from the Saretha and Sunnabile give rather the impression of being merely cane varieties which have undergone slight modifications through being long grown under special climatic conditions. They would thus appear to be of later origin and are, as might be expected, much more restricted in their geographical range. The same line of development might be suggested lastly for the thick cane group, if we are to regard them also as having arisen in India from a wild ancestor. But it occurs to the writer that, in considering their characters, we may have to look to another place for the origin of the tropical forms. The common origin of the whole of the cultivated sugar canes was assumed at a time when no careful morphological studies had been made of them. During the past eight or nine years this part of our knowledge of the sugar cane has made great strides, and various systems of natural classification has been worked out, founded on variations in the character of the different vegetative organs of the plant. A serious attempt has, at the same time, been made to form a continuous series, commencing with the wild *Saccharum spontaneum*, passing through the indigenous Indian canes, and culminating in the thick tropical varieties which form the main source of our commercial sugar in the tropics.

In many sugar growing countries, where the conditions have proved adverse to these comparatively delicate thicker canes, members of the Indian groups have effected a footing. The most important, from our point of view, of these introductions has been that into South America, for it appears to have occurred so long ago that no one can say exactly when it took place; and it has only been by the exact study of the Indian groups that the source of the immigrant has been definitely settled. This throws some light upon the theory, somewhat loosely held, that the thicker tropical forms have been derived from the more primitive Indian forms by long acclimatization in warmer, moister regions. Influenced by this belief, a series of the North Indian forms were brought down to Madras some eight or nine years ago and grown continuously under the same conditions as the tropical canes usually planted there. It was desired to see if any change in the direction of thick cane characters would take place. The period is of course far too short for any reliable opinion to be formed, but it may be recorded that there appears to be no trace of any change. The discovery that the South American thin canes were of the Pansahi group, still retaining all the peculiar morphological characters of that class, was at once recognized as of importance in the enquiry; and it was this that first suggested to the writer that the gulf between the Indian canes and those of the tropics was insuperable within the limits of agricultural time. The idea of a separate origin of the thick cane group has recently been strengthened by an appreciation of the fact that, at one time and another, the finest of the tropical canes have been received from among the islands of the Pacific, where no careful agricultural selection was likely to occur. The supposed origin of the Bourbon cane from Malabar need not be taken very seriously, for anyone acquainted with the character of the canes growing there will find it difficult to believe that such a form could have been otherwise than a temporary introduction by the Portuguese, if ever it got there. Quite recently a magnificent series of new canes, fully equal to any that have brought wealth in the past to the cane growing countries of the tropics, have been discovered in the unexplored recesses of New Guinea, a place sufficiently remote to make it practically impossible that these could have been derived from India. We are driven then to conclude that the thick cane group, essentially different in so many respects from the indigenous Indian ones, has arisen from a separate centre, namely the mountainous islands of the Malay Archipelago and Polynesia. It is interesting to note that *Saccharum spontaneum* is recorded as indigenous in many of these islands as well as in India, so that we have still the possibility of this species being the ancestor of the thick canes. But it seems to the writer probable that, in the absence of connecting links, it is more reasonable to assume that the thick canes as a group arose rather from an allied species now lost in the wild state. This separate origin would do away with the anomaly that, while in the Indian series the capacity of producing fertile flowers and seedlings steadily diminishes with distance from the wild form, it returns in full force with the thick canes, which in any connected series from a common origin would presumably be the most highly developed of the cultivated varieties and groups.

C. A. B.

Sugar Cane Seedling Work in India.

By Dr. C. A. BARBER, C.I.E.

PART I.

The present note was first suggested by some queries as to the arrowing of the sugar cane in the *South African Sugar Journal* of August and September, 1919. The cane does not appear to arrow freely in Natal and a more frequent occurrence than usual naturally led to speculations as to possible seedling work there, with the idea of improving the stability of the Uba cane which is the main kind grown. Arrows were collected and have been sown and the results are awaited. It is quite possible that this experiment may turn out unsuccessful for, as will be seen, the arrows of members of the Uba class are sterile in India and they may also be so in Natal; but this is no reason why this important work should be given up there, for there are many lines of work open, some of which will undoubtedly suggest themselves to the officers in charge of the experiment stations after reading this account of the Indian work. A further reason for publishing a resumé of the Indian work is that it would appear to be unknown to the workers in the New World, for there is an absence of references to it in recent accounts of seedling work there. This of course does not apply to the West Indian and British Guiana publications, in which the foundations of cane seedling work were laid down many years ago, but to places which have more recently commenced to raise seedlings, as in Porto Rico and Argentina, where the studies are still in their initial stages. In one respect the work in India, carried out at the Coimbatore Cane-breeding Station, is unique, and that is that it was not a question of merely raising cane from thick tropical parents, but of obtaining definite crosses between these and the many thin, indigenous Indian canes; and not only so but of obtaining sets of seedlings suited to the very different conditions in the sugar tracts of this great country. This use of Indian canes as parents has greatly broadened the outlook and many facts have come to light which have not been noted in the ordinary seedling work hitherto carried out in different parts of the world. It has, for instance, been found quite feasible to use the wild Saccharums as parents, and some of the children obtained by crossing these with cultivated canes appear to be of high promise, both in vigour and sucrose content, especially for those parts which are liable to injury from frost or drought.

The possibility of producing cane seedlings in India. A considerable amount of work has been done on this subject at Coimbatore and various references to it have been published from time to time,[1] but a specially useful article appeared from the pen of Mr. T. S. VENKATARAMAN in a recent number of the *Agricultural Journal of India*, in which he summarizes most of the work on cane arrowing. The main line of work set for themselves by the officers of the Cane-breeding Station was to produce seedling canes which could with advantage replace the host of inferior kinds grown in the millions of acres of the North Indian sugar tract.[1] When the station was started, seedling canes had not been produced in India, with the possible exception of a few which died in infancy at the Samalkota Sugar Station some dozen years ago. This was not because attempts had not been made, and it was suggested that the extreme dryness of the air might have withered the pollen or ovaries in the flowers. On the appointment of a whole time officer, however, the question was at once taken up. In the Christmas holidays of 1911 a number of arrows were collected and sown in some 300 pans at Coimbatore. A mass of seedlings were soon observed but most of these turned out to be grasses and, finally,

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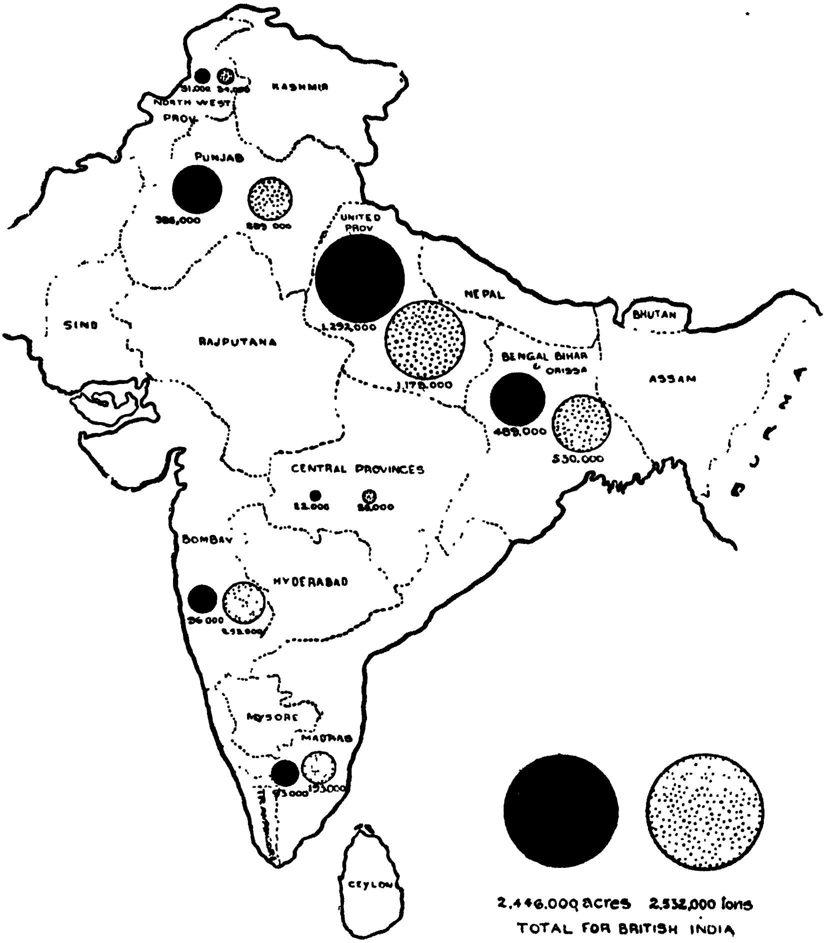
[1] See references at the end of Part II of this paper.



MAP SHOWING THE TWO SUGAR CANE TRACTS OF INDIA.

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[1] The relative importance of the two sugar cane tracts of India can be judged by a reference to the accompanying map, reproduced from Bulletin No. 94 of the Agricultural Research Institute, Pusa, 1920, by T. S. VENKATARAMAN, B.A., Acting Government Sugar Cane Expert, Madras.

only 11 undoubted cane seedlings were produced. The flowering period was practically past and it was proposed to leave the matter over until the next year, but a study of the inflorescences used showed that most of the stamens were unopened and the available herbarium material was examined to see if there were any kinds in which this was not the case. The flowers of three kinds were found to have open anthers and, after some correspondence, a set of arrows was received from Bangalore of one of these kinds, and was immediately sown, with the result that 50 healthy seedlings were easily obtained. As a result of further study it was found that, when the anthers were open, there was abundance of good pollen present but when they were closed they merely contained a mass of undeveloped pollen mother cells. The Java test was applied, in which the presence of starch grains in the pollen indicated fertility and it was found that in every case the open anthers had such pollen while in the closed anthers no starch was present in the pollen grains even if they were formed. Open anthers thus would appear to be the sign of male fertility,—and this recalled an observation made some years previously by the writer on the cropping of pepper (*Piper nigrum*) on the west coast. It was noted there, for a vine to bear, it was necessary for open anthers to be present in abundance, and it was also noticed that, once the anthers had opened they remained so permanently, so that the fertility of a plant could be determined years after in herbarium specimens. This experience was applied to the sugar cane arrows, and the same fact was noted and, in place of the somewhat tedious Java iodine method, the presence of open anthers was taken as the sign of fertility of the male organs. It was at once applied to the arrows in use or received in correspondence, and this was easy, as the examination of the inflorescences could be postponed for months and did not need to be undertaken until the rush of the work during the flowering period was over. Every arrow used for the production of seedlings was submitted to an analysis and this has formed an integral part of the work of the station right through; further, every variety of cane introduced on the farm was similarly examined as to male fertility whether it was used or not, and collections of arrows made from all parts of India where they appeared were also tested. And this collection led to fruitful results, in the following manner. It was found that arrowing was rare in North India and that, when it occurred, the stamens were almost invariably completely closed and no pollen was formed. This explained the former failure to raise seedlings in India, for all of the attempts had been made in Northern India with the solitary exception of the Samalkota one referred to above. Every arrow used on the farm is placed in tissue paper for subsequent examination; 200 stamens are shaken out and these are passed under a hand lens to see which are open, and the stamens are separated into three classes, open, partly open, and completely closed. The results have been kept in a special register. To illustrate the sterility of North Indian cane flowers the following details may be given of the Saretha variety, one of the few kinds which flower in North India. A set of arrows was received in 1915-16: those from Shahjahanpur (United Provinces), Sipaya and Sabour (Bihar), Jubbulpore (Central Provinces) had no open anthers at all: some received from Pusa (Bihar) had 4 per cent. open, while those grown at Coimbatore have habitually over 90 per cent. open. The frequency of flowering is illustrated by the following:—in 1917, two canes flowered at Shahjahanpur, three at Pusa, six at Sipaya, six at Jubbulpore, 16 in Nagpur (south Central Provinces), 71 at Coimbatore.

Obtaining crossed seedlings at Coimbatore.—Large collections were now made of varieties of cane from every part of India, including both the indigenous canes used for gur making and the introduced thicker tropical varieties, grown everywhere but used in the north only for eating as a fruit as they cannot usually be ripened for sugar making, and some 200 to 300 kinds were got together. But it was found that crossings were not very easy to obtain between these two classes, and the first successful batch of hybrids, obtained in 1912, was between a small North Indian cane and the wild *Saccharum spontaneum*, whose period of flowering is less limited than in cultivated canes. The North Indian canes were shy of flowering at first and, when they did so, it was noted that their pollen was infertile, whereas, curiously enough, the thick tropical kinds formed masses of healthy flowers, from which seedlings could be raised in any quantities here as elsewhere in the world. This raising of seedlings from thick canes was carried out for the first year or two, to obtain better varieties in South India, to gain knowledge on the subject and for the sake of practice, but the aim all along was to obtain crosses between them and the indigenous Indian canes.

The first problem was to make the canes to flower. The North Indian canes were at first obviously out of their element and it was only later that, by altering their treatment, good healthy plants were obtained. Even then flowering was scarce among them on the farm plots, and a special study had to be made as to the cause of this. The flowering time was found to be strictly seasonal, usually commencing in October and lasting about six weeks, an unfortunate time for study because this period synchronized with that of the north east monsoon when over half the annual rain fell, accompanied by storms of wind which rendered the work of manipulating the arrows very difficult. Planting on the station was at the usual time, February to March, and the canes were reaped a year later, no arrows being formed. But it was found that, if the canes were planted in November, they flowered in the following October. Hence a series of "arrowing plots" were laid down, plant canes and first ratoons, and this part of our difficulty was solved. There are two classes of sugar cane land at Coimbatore, "dry" of a lighter nature and irrigated from wells and then termed "garden land," and "wet," very heavy clay irrigated for many years from tanks. The wet land had been created from the dry by this perpetual irrigation, through which the finer clay particles had accumulated during many years. It was noted that, in the wet land, canes planted as late as March or April would generally flower in October, and thus much of the earlier work was done with arrows collected from this source. The cane farm was chosen deliberately on the dry land, because this was more in keeping with the land of the sugar cane tracts in North India. The following figures of thick and thin canes flowering show the results obtained in our efforts at causing the canes collected on the farm to flower. The first figure in each year is of thick cane varieties and the second of thin :—

1912, 3, 0; 1913, 0, 0; 1914, 5, 4; 1915, 35, 36; 1916, 62, 34; 1917, 83, 52, besides among our own selected seedlings, 183, 103.

The effect of the weather on flowering.—It was soon noted that the mass of flowers produced was very different in different years, and a study of the rainfall showed that this was a factor of some importance. In North India the arrowing of the sugar cane varies a great deal, being rarer and rarer as the Punjab in the north west is approached, and there it is unknown. In certain tracts it is recorded that the appearance of the arrows in the cane fields is regarded as a grave portent and whole villages are said to have been deserted from this cause, for fear of the drought and famine which followed in its train. Flowering is common in the Peninsula, but is much more abundant in the drier, western than in the moister, eastern regions. At Coimbatore, itself in a semi-arid tract, it was found that good rains during the growing season had a markedly beneficial effect on the number of

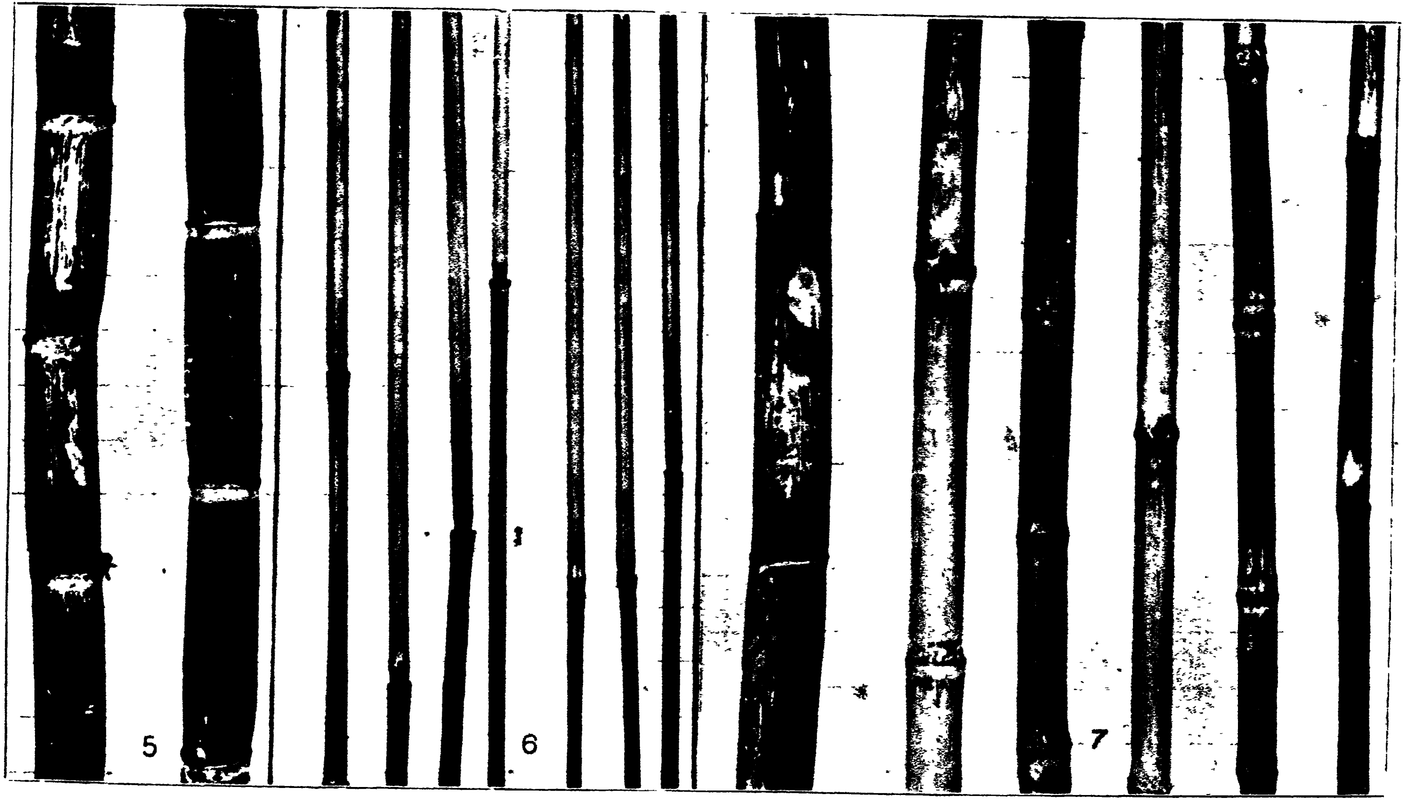

PLATE I.—Vellai × *Saccharum Narenga* (1913-15). Canes of Parents and Seedlings.

5.—Two Vellai Canes. 6.—*Saccharum Narenga* Canes. 7.—A Selection of the Canes of the resulting Crosses, from the thickest to the thinnest, one average Cane from each of six Seedlings.

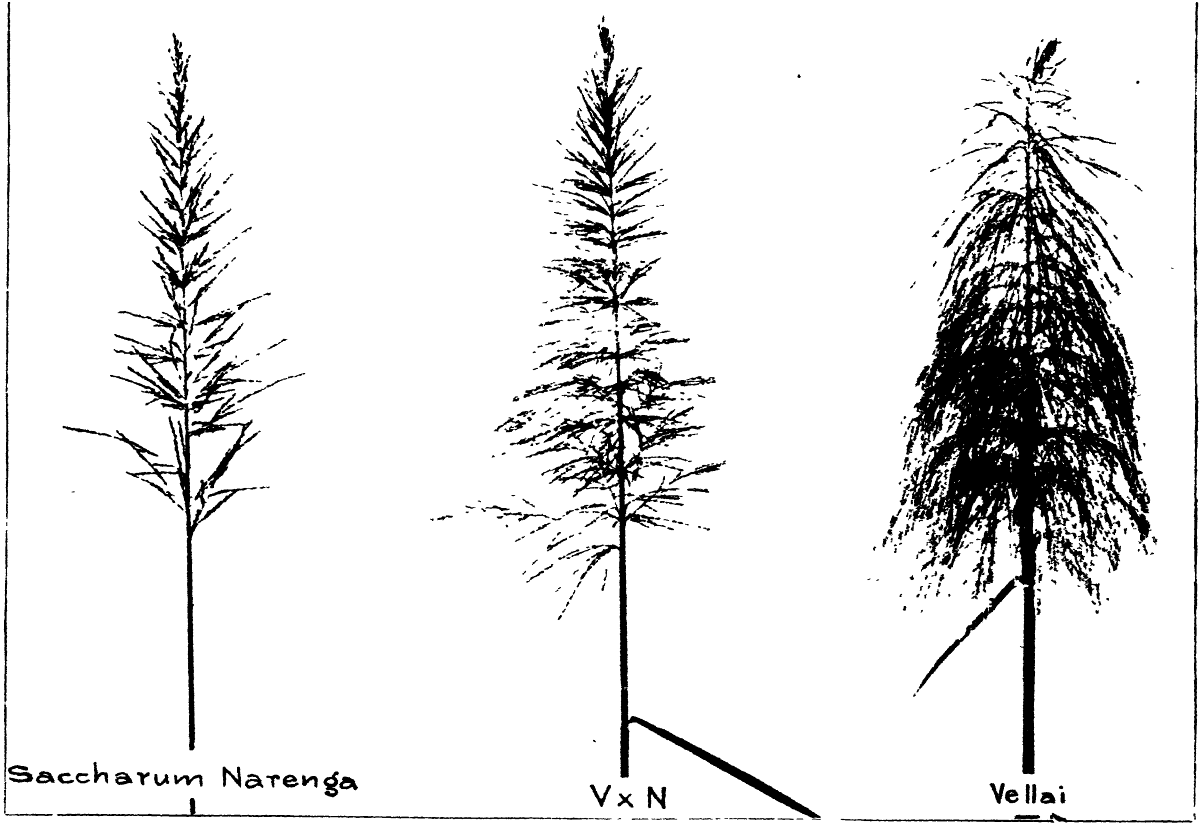

PLATE II – Vellai × *Saccharum Narenga*. Arrows of the Parents and of a typical Cross

arrows appearing. The wet land showed plenty of arrows and, on the farm, it was found of advantage to place the arrowing plots on places liable to be flooded in the rainy season. Here then we have two opposing views as to the effect of the weather on arrowing and it is somewhat difficult to reconcile them. If we might hazard a solution, flowering is probably aided by some interference in the normal progress of growth, some check, whether from drought or waterlogging, and this is in general agreement with a practice in horticulture, for instance, in making azaleas to bloom freely by introducing them into pots too small for their free growth or in injuring fruit trees to make them fruit more abundantly. It may be noted that the reports from Natal indicate that the Uba cane flowered abundantly in places where the rainfall was deficient, thus falling into line with the North Indian experience.

We thus see that arrowing of the cane in India is affected by latitude, by the time of planting and by the character of the soil and its treatment, while the usefulness of the arrows for the production of seedlings depends in the first instance on their possession of abundance of opened anthers. Although enough data have not as yet been accumulated for clearing up the matter thoroughly, it is evident that the amount and character of the rainfall also have a direct effect. As we shall see later, the habit of flowering is a character of some importance in classification, the greatest diversity occurring among different canes in this respect.

The determination of female fertility.—This is by no means an easy matter and we have usually had to record the previous behaviour of each variety in order ultimately to form an estimate of the chances of obtaining seedlings when using it as a mother. And we have learnt from our experience that the arrows vary as much in this particular as in the fertility of the male organs. Working along these lines it occurred to Mr. VENKATARAMAN that the presence of starch grains, which had proved so useful in determining the fertility of pollen in the sugar cane, might also be shown in the stigma. This was proved to be the case, as far as the very extensive trials at present made can be taken as a guide. If the stigma and style have starch grains in them then the probability is that the flowers are capable of producing seed and seedlings, but if there is no starch the chances are against it. This important discovery has lightened the work of crossing at the Cane-breeding Station very considerably of later years, by the avoidance of large numbers of crossings which would turn out useless, and concentrating on such as would, other things being equal, turn out successes.

Variations in the time of flowering.—Having thus at length obtained an abundance of arrows from different varieties of canes on the station, the path of progress was arrested by the annoying fact, which soon obtruded itself, that, within the limits of the season, the different varieties had their own particular time of flowering. The thick canes as a class flowered earlier than the thin; when the latter opened their flowers, most of the thick canes had faded or were at any rate past their prime and more or less useless for crossing. The following will give some idea of this phenomenon. Among the thick canes, Vellai, with often almost entirely closed anthers, leads the way, its flowers opening during the 2nd and 3rd week in October; Karun, Chittan and Kaludai Boothan follow; then D. 74, Mauritius 16 and Java and, in the middle of November, Pachrangi and Moradabad. The thin canes are led by the Pansahi group, also generally devoid of open anthers, at the end of October, then the Saretha group commences flowering and these are followed by the Nargori and Mungo groups. It thus happens that Vellai with its male sterility is over before the Saretha group comes in with its masses of fertile pollen, whereas the Pansahi group is obviously useless for this cross because of its own male sterility. These and similar difficulties have constantly hampered us in our efforts at obtaining the much desired crosses, for a good mother, that is one that has no good pollen, is rare and obviously of great value. There is some evidence that in many cases there is prepotency of the pollen in its own flowers and, in numberless experiments of dusting foreign pollen on arrows with male fertility, no trace of the foreign blood has been observable although it is only fair to say that important exceptions occur and the method has its value. In these circumstances we have turned to whatever arrows were available and there is one set of our seedlings which have been of the greatest service. It has all along been observed that, in every large batch of thick cane seedlings, a very small proportion show remarkable differences from the usual type. These seedlings have strange forms, quite unlike the parents or any cane growing on the farm; they are immensely vigorous but have low sucrose content, are in fact in some respects more like the indigenous Indian canes than seedlings of thick canes. They have the power of producing masses of flowers which are specially fertile, yielding great number of seedlings, and which when selfed show no approach to their thick ancestors but remain true to the new type. These we have called "rogues." They differ from the other canes growing, in that they flower early, and are thus available for crossing with Vellai and indeed most other thick canes as mothers. It was at first thought that they might be accidental crosses between the thick and thin canes, but they have again and again appeared before any of the latter are in flower. And a similar use has been made even of the wild canes, which are less strictly limited in their periods of flowering. Thus Saccharum Narenga begins to flower a good deal earlier then Vellai and continues so to do throughout the flowering season, and a fine series of crosses were obtained between these two. Narenga is a grass and does not form a solid cane, and the crosses show canes varying from one to six feet in length (Plate I). But all attempts to make further use of these seedlings have been unsuccessful for, although they are profuse in flowering, they are absolutely sterile both in the male and female organs. The difference between the parents in this cross is too great, and they are apparently all of them "mules." But by crossing Vellai with *Saccharum spontaneum* some very useful seedlings have been obtained, certain of them sent to the Punjab giving a very good account of themselves. Meantime, the most various devices have been adopted to retard the early flowering of the thick and hasten the late appearance of the thin canes, with the result that some of the latter have been hurried up, and a number of crosses formerly unobtainable have now been secured.

Degree of development of the arrows in different canes.—The different varieties and groups of canes show great diversity in this respect, more so indeed than in the times at which they flower. We have all stages, from some which have never been known to arrow and have not done so with us, through those that are beginning to yield to treatment and up to such as readily produce masses of fertile flowers on the least provocation. The fullest development of arrows is found, somewhat strangely, in various highly developed thick canes, as well as the most primitive class of the Indian indigenous ones, these forming the extremes in sugar cane evolution. The latter are typical of the Punjab and it is fairly safe to say that most of these have never flowered since they were first introduced to cultivation there, for canes have I believe never been known to flower in the Punjab. While it is natural to suggest that this readiness to flower in these primitive canes may be connected with their nearness to the wild state, this cannot be assumed with regard to the rich and highly developed forms which show equal readiness to flower. Many of the North Indian canes have been induced to flower on the farm for the first time within knowledge, some of them it is true in a very half-hearted way, but it is legitimate to hope that, with further study, the tardy and at present infertile members may some day produce flowers which will add to the range of our crosses. Each such form has some good points, whether in erectness, or short and sturdy habit, self-cleaning or drought resistance, and it would be of advantage if these could be added to our list of useful characters in the field.

The great Saretha group heads the list in producing masses of flowers from which any number of seedlings can be raised; the group has, however, its defects. Its members are liable in a greater or less degree to be infected by smut, and this is a very serious disease in certain important sugar tracts in North India. It may be noted that some of the Java seedlings with a male parentage of members of this group are similarly liable to smut. A second fault, shared it is true by others, is that the selfed seedlings are as a rule of very inferior character, many of them mere tufts of grass; one indeed was found crawling along the surface, with stems 20 feet in length and the thickness of a lead pencil, and never raising themselves off the ground. The seedlings thus far raised have juice very inferior to that of their parents. In one year 700 strong seedlings were raised by selfing Saretha, the type variety and perhaps the best all round variety of the group. These were grown to maturity in the vain hope of obtaining one or two which had good habit and juice of a better purity than that of the parent, but nothing was gained by the experiment. The Sunnabile group flower sparsely, and very few of them produce seedlings. The varieties of the Pansahi group, of which Uba is a member, produce enormous masses of beautiful large arrows but, as a general rule, these are male sterile and hitherto the crosses have not been of special value, excepting perhaps in general vigour and good habit, in which character they resemble their Pansahi parent. The juice is usually not good as far as I remember. In the Nargori group the arrows are deformed and the flowers ill-formed, often only half protruded. The Mungo group does not appear to be likely to be of much use in crossing, much as this is to be desired; the arrows when they are formed rarely protrude from the sheaths, forming inside the merest rudiments of flowers. In the thick cane group, there are all stages from complete sterility to abundant seedling production and, in the latter case, all stages of robustness have been noted. In one case out of 4000 apparently healthy seedlings it was only possible to raise two, although the greatest care was taken of them in all stages. A mass of information can be extracted from the carefully kept office registers in the Cane-breeding Station on these and similar points. All attempts at selfing good seedlings have been given up, on account of the generally inferior nature of the resulting second generation of seedlings. The arrows of different kinds of cane are often very different in form as well as in fertility, and this fact has been of use on several occasions in disentangling the different arrows where the kinds have been growing close together in a crowded field. Several errors in classification have also been corrected by noting the time of protrusion of arrows and their form when protruded. Perhaps the most interesting case of these differences is that met with in the crossing of Vellai by *Saccharum Narenga*, where the arrows of the seedlings are obviously in many respects half way between the very different ones of their parent. This is shown in Plate II.

Plates I and II are reproduced by kind permission of the Agricultural Adviser to the Government of India, from C. A. Barber, "Studies in Indian Sugar Canes," No 2. Memoirs of the Department of Agriculture in India, Botanical Series, Vol. VIII, No. 3, July, 1916.

Australian Sugar Possibilities and a Self-contained Empire.

Lost Opportunities and Other Wastes.

By D. T. CHATAWAY. Ex-Senator for Queensland.

Speaking before the British Empire Producers' Organization in the early part of 1916, Mr. WILLIAM MORRIS HUGHES, then and still Prime Minister of Australia, declared that there was nothing to prevent the British Empire supplying all the sugar required by the United Kingdom, and he emphasized the point that Great Britain need no longer be dependent upon foreign countries for her supplies. When saying this he doubtless had his own country largely in view. To-day the Commonwealth can in a year of good rains and absence of disturbance—seasonal or industrial—supply all her own requirements. A few years ago it seemed as if Australian sugar production, being unable to export profitably at the prices then current in the world's markets, would have to cease expansion. It would become stagnant, except in so far as the growing population of Australia would enlarge its local market. Indeed, the agreements made between the refiners and the manufacturers of raws actually provided for sharing the loss in the event of exportation being necessary, and when during the war the Commonwealth took over the sugar supplies from the Queensland State Government a proviso was made in the contract that no new mills were to be erected, in order that production should not exceed the Australian demand. To-day, mainly due to seasonal causes, the output is insufficient to meet local requirements, but the first good season in the cane sugar areas will remedy this. Throughout the war Australian consumers have been paying a fixed price of 3½d. per lb., the merchant paying the refiner £29 odd, according to port. It may questioned whether at any time in the near future the world's prices will fall below what the *International Sugar Journal* has called the "dirt-cheap" price the Australian producer has been receiving, and at which he has maintained his industry. The purpose of this article is to show in what way and by what means Australia can be expected to increase her production, eliminate her wastes, and thus do her share to justify the optimism of her own Prime Minister.

For the present Australian sugar production is practically confined to the north-eastern State of Queensland, and all the sugar is the product of the cane. New South Wales, close to her north-eastern border, still makes some ten to fifteen thousand tons of cane sugar, according to season, but the industry is dying out and making way for dairying and mixed farming. In Victoria there is one sugar factory—beet—which requires much propaganda and optimism to keep it supplied with roots to produce 1500 to 2000 tons of sugar. So little is the value of the sugar beet industry recognized that one member of the Victorian State Government quite recently expressed the opinion that the cultivation of sugar beets was the mere growing of a "fancy crop." Sir HENRY JONES, head of the jam-making corporations, stated in Tasmania recently that before the war he was enquiring into the cost of sugar machinery in Belgium, as jam manufacturers had thought of starting the production of beet sugar in Tasmania. The call for the production of sugar has greatly increased during the war, especially for jam making, the exports of jam having risen from £29,402 in 1913 to £1,410,548 in the year ending 30th June, 1918. There have also been very notable increases in exports of condensed and preserved milk and biscuits, while since the end of the war the exports have in no way fallen off, showing that war conditions are not essential to the maintenance of the export trade in these sugar-consuming articles.

Thus then there is a waste of opportunity, which might well be eliminated. Both in Victoria and in Tasmania beet sugar production is possible, and on the excellent authority of Sir Henry Jones it would have been profitable even before the war; much more must it be so now with sugar at treble its former price. The soils, the facilities for irrigation, and a strong local demand for the manufactured product, together with the fact that capital is available, as shown by Sir Henry Jones, indicate that in respect to beet sugar production Australia is turning a deaf ear to the persistent and clamorous knocking of opportunity.

In the Queensland cane sugar areas there is ample room for expansion, but there is also a great amount of waste in production. The causes of this are more complicated than at first appear. The disappearance of coloured labour from the sugar mills was immediately met by the installation of mechanical equivalents—mechanical unloaders from tram and railway trucks on to the carriers, self-feeding furnaces, continuous subsidence, automatic bag-filling, weighing and, perhaps, sewing, stacking elevators, and other labour-saving devices. In the fields, however, the industry is still back in the early nineties. There are a few motor-driven ploughs and cultivators, and his horse machinery in this part of the work is as modern as the small farmer can afford, but once the crop is grown and must be harvested, the old-fashioned knife of our grandfathers comes into requisition, though there is an increase of, say, 600 per cent. in the cost of wielding the knife. Sugar cane once harvested at 10d. per ton now costs anything from 5s. upwards. White labour costing £3 12s. per week of 48 hours picks up each individual stick of cane and stacks it on a tray or a truck. The field loader is unknown, though I believe it has been tested without giving complete satisfaction by the Colonial Sugar Refining Company. With machinery for cutting and loading the most attractive wages could be paid to skilled men—wages which would cover the multitude of sins with which the white man usually charges the tropical climate.

There have been many attempts made in Australia to complete a sugar cane harvester; and a few months ago the Australian Sugar Producers' Association sought the aid of the Queensland State Government to introduce, for trial purposes, the Luce machine in use in Louisiana. It was hoped that either the Luce or a modification of it would suit Queensland conditions. The Government, however, being dependent for much of its support upon the sugar field and factory workers declined to take action. Local inventors have largely been hampered by endless and contradictory advice, and an ambition to make a machine which will cut, top, load, and even chaff the tops. The late Mr. Hurry, of Melbourne, spent thousands of pounds, but it is questionable whether his machine ever had a proper trial. The simplest machine (probably a small steel rotatory saw, electrically driven through a flexible tube) is necessary, as the question of cost is a serious matter to the small farmer. He cannot afford £2000 or £3000 for a machine which will lie idle ten months in the year. For the same reason the A.S.P.A. asked the Government to import the Luce, which would have cost landed about £3000. If the bigger and costly class of machine is eventually adopted it will become necessary to form harvesting co-operative companies, similar to the shearing companies in the western country, who will take contracts from groups of farmers residing in one locality. The fact that the cane industry is in the hands of some 4000 cultivators is a source of strength—both industrial and national. The farmers are workers; strikes in the mills cannot succeed, for the farmers go into the mills, and keep them going. Strikes in the fields are only moderately successful. They mean half time for the mills, extra expense and much inconvenience, but they need not necessarily be fatal. But this absence of the capitalist is a source of weakness if scientific or mechanical improvements are to be tested, developed, and finally adopted.

There are still large areas of land in Queensland well suited to the growth of sugar cane, which at present lie undeveloped. It must, however, be assumed that no Government, certainly not the present State one, would dare to propose giving an opening to cultivation on a large scale by capitalists. True the latter might introduce irrigation, if necessary, improved machinery, scientific fertilization, such as produced eight tons of sugar to the acre in Hawaii, and eventually actually cut up their holdings into small farms, even as the planters did thirty years ago; but the popular mind in the State is against any such venture. It has been taught to fear the "big" man, and to see in any man who does not hold the handles of a plough, or be in a constant state of perspiration from manual labour, a member of some gigantic trust, which will find its way on to the land and into the homes of the small cultivator, and oust him therefrom. The capitalist who might have a remedy for the Queensland waste in the field is therefore excluded from Queensland.

There are, however, great areas at present lying unused in the Northern Territory. There are splendid rivers, some navigable for small steamers for a hundred miles or more from their mouths. They offer every facility for irrigating the excellent lands adjoining them—lands which in any case enjoy for six months of the year a rainfall of from 30 to 40 inches. The Commonwealth has nominally been in control of these lands for the last twelve years, but the administration, initiated under a Labour Government, has been obsessed with the idea that only the small man, who can handle three or four hundred acres, grazing and cultivation, should be permitted to enter upon this neglected paradise. But there is a new spirit coming over the Australian mind in regard to the Territory. Recent events have done much to make people give the matter some thought. The folly of expecting a poor man with his wife and children to go into the wilderness and hew out a home for themselves veritably thousands of miles from civilization! It is to place oneself in company with the Chuzzlewits and Tapleys in their search up the Mississipi for the city and settlement of Eden. To-day it is quite on the cards that a reasonable proposition to take up a large area of land for the cultivation of cane and the manufacture of sugar would meet with very careful consideration. The Commonwealth would guard against speculators, pure and simple, but otherwise it is so harassed with the failures of the past that it would welcome an opportunity of making a success of the future. There is room in the Territory for the production of 1,000,000 tons of sugar, nor need the Europeans fear the climate. The suitable areas are not along the foetid coast, but on higher ground some 200 miles inland. I emphasize this matter of big areas, because as I have said the small man is a source of weakness as well as one of strength. As in all countries, the pioneer land settler requires the backing of capital or labour. The one he has under modern conditions; the other he enjoyed in the great migrations of history. The small man may stay, but he cannot progress unless very slowly. He has not the capital to risk, and too frequently not the broad and comprehensive outlook which comes from education in the best sense of the word.

There is yet one more lesson which, it occurs to me, the small sugar growers might learn were there once again some large estates under capable and progressive management. Let us glance for a moment at these official figures, quoted by Mr. HARRY T. EASTERBY, General Superintendent, Bureau of Sugar Experiment Stations, Queensland. While he used the figures for 1916, they apply *mutatis mutandum* to any of the years since Federation:—

MOLASSES.	GALLONS.
Total quantity recorded	6,432,439
Sold to distillers and others..	818,812
Used for fuel..	433,500
Used for manure	54,600
Used for feeding stock	1,439,108
Held in tanks at mills	797,084
Balance run to waste..	2,799,335

Approximately, we are told, 11,000,000 gallons have been wasted in the five years ending June, 1917, and the "quantity shown as run to waste would be very much larger if all the mills furnished full details of their production." Mr. RUSSELL GRIMWADE, B.Sc., dealing with the question of the supply of raw materials from which alcohol to take the place of petrol might be made, said: "Of molasses, which is the ideal raw material for alcohol, there is really not a great deal. If all the molasses of Queensland were collected and converted into alcohol, it would only produce sufficient to replace the petrol requirements of that State, and the most commonsense way to regard the molasses question is that Queensland is specially favoured in producing its own supply of power alcohol." Taking the American census valuations the wasted molasses in Queensland are therefore worth less than £40,000 a year, but Mr. GRIMWADE assures us that they could replace all the petrol used in the State. If that is so, how much more could they supply all the alcohol required to drive farming implements, tramways, and, one of these days, cane-cutting machines and loaders? In the old days of big estates in Queensland there was a number of rum-distilling plants attached to the sugar factories, and their product took a not insignificant place in the prices of Mincing Lane. To-day there is only one rum distillery of importance, and that, be it noted, is connected with a big plantation which has not undergone the process of disintegration. Obviously with the large number of small farmers it is not easy either to arrange for distilleries, or to induce them to replace their horses with motors operated by alcohol power. It is not possible in the brief space of this article to calculate the savings to the growers in housing, feeding, harnessing, doctoring, etc., if the thousands of horses now used were dispensed with, but it is obvious that with motor power the expenditure side of the grower's annual statement would be greatly reduced.

It was the evidence of their own eyes which brought the small farmers together as the co-operative owners of sugar mills, and gave them by means of large estates on some of the unsettled lands optical evidence of the possibility of eliminating the wastes I have mentioned, and they will follow the examples and in time do the same. Thus there is no reason why Australia should not alone make good the boast of her Prime Minister that the Empire can supply the United Kingdom with all the sugar she requires. We have the land, the rainfall, and the irrigation facilities, both for cane and beet sugar production. There are serious wastes at present, but they are capable of correction. The tropics have no terrors for the highly-paid European artisan or mechanic, and in a thoroughly equipped cane sugar industry there should be little need for the ordinary unskilled manual labourer. Machinery will take the place of the gang in the field, just as it has taken that of the gangs at the cane carriers, and in the stokeholds and sugar-houses of the factories.

Continental Beet Sugar Notes.

The 1919-20 European beet sugar crop is practically over, and although a small quantity of after-products may still be forthcoming from the factories, we are now able to give the final figures of that crop with a fair amount of accuracy. The only country as to which one must make a guess instead of possessing definite figures is, naturally enough, Russia, from which region reliable news is still very scarce. Allowing for this doubtful factor, we give in the following table the result of the last beet sugar crop in Europe (in metric tons).

	Metric Tons.
Germany (exclusive of the ceded territory)	742,000
Czecho-Slovakia	550,000
Russia (Poland, Ukrania and Soviet Russia)	250,000
Netherlands	236,000
Belgium	145,000
France	172,000
Italy	170,000
Spain	125,000
Denmark	160,000
Sweden	140,000
Other countries (Hungary, Switzerland, Bulgaria, etc.)	50,000

Unfortunately for anticipations a very severe frost visited Central Europe as early as the first days of November. The western part of the continent suffered too from very cold weather and heavy snowfall, but the beet crops of France, Holland and Belgium were fortunately not reduced by that adverse circumstance. On the other hand, the crops of Germany, Czecho-Slovakia and Poland fell far below the earlier estimates. In these countries only a relatively small portion of the beets had been pulled when the cold wave arrived and froze the soil to such an extent that the beets had to remain in the field till the advent of warmer weather. When, however, the snow thawed, the land was so soaked with moisture that harvesting became more and more difficult and expensive. so that both farmers and labourers were reluctant to do the necessary work, if no extraordinary high price for roots was forthcoming to tempt them.

In order then to allow the sugar manufacturers to pay the higher price necessary to induce farmers to pull their frozen beets, the German Government raised on January 1st the price of refined sugar by 25 marks per 50 kg. and fixed it at 88 marks, with an increase of 0·55 mark per 50 kg. per month after January. These 25 marks per 50 kg. are to be paid by the refiners and the manufacturers of granulated into a fund, after having deducted the traffic duty, so that everything which they receive net above the price ruling before January enters into that fund, which is to be divided among the manufacturers of raw sugar in the following manner: Manufacturers, having during the 1919-20 campaign sold beets to other manufacturers, receive for those quantities 1 mark per 50 kg., provided they have not already obtained an extra bonus over the maximum price fixed by the Government. Manufacturers, who closed their business for good and all do not receive anything, while those still working after December, 1919, receive a premium of 6 marks per kg. of sugar produced in January, 12 marks for sugar made in February, and 20 marks for the production of the months after February. The money still on hand after payment of these premiums is equally distributed among the manufacturers according to the quantities produced.

The additional sums received by the manufacturers serve to reimburse the farmers for the higher expenses incurred by them in consequence of the troublesome harvest. The manufacturers have to pay at least three-fourths of the amount to the farmers, and only in case a manufacturer can prove that the balance will not be sufficient to pay for his own higher expenses is he entitled to reduce the portion to be paid to the beet growers to two-thirds.

In Czecho-Slovakia and in Poland the authorities have also done their best to induce the farmers to pull as many of the beets as possible in order to try and swell the sugar production, but the results have everywhere been very meagre. The German estimates at the outset of the campaign were 800,000 to 900,000 tons, those of Czecho-Slovakia 750,000, and of Poland 75,000, while the final output of those countries has been respectively 742,000, 550,000, and 38,000 tons.

The Western European countries (Holland, Belgium, France, Denmark and Sweden) have everyone of them surpassed estimates, a fact which has not been witnessed since the outbreak of the war. Italy too is rising to her former production; but Spain is still behind her own consumption and needs to import in order to keep supplied with sugar. It thus appears to the close observer that in the 1919-20 campaign the European sugar production has attained its lowest level, and that the 1920-21 one will be more favourable.

The German sowings will very probably be extended by about 10 per cent., and for the first time since 1915 a good supply of Chile saltpetre will be at the disposal of beet growers. It is very improbable that this year a similar premature frost will occur, and as the early spring and very favourable weather has promoted germination and development of the young beet plants, the prospects of the crop in Germany are much brighter than last year. It is not impossible that Germany will be able to produce in 1920-21 900,000 to 1,000,000 tons of sugar or 30 per cent. over last crop. Reports from Czecho-Slovakia speak of the extension of sowings in Bohemia, Moravia and Silesia, but principally in Slovakia; the percentages of extension have not yet come to hand but, since in that country too the weather is uncommonly fine and the calamity of severe frost in November is not likely to occur two years running, the final production of the Czecho-Slovakian State in 1920-21 will in all probability be much better than that of 1919-20.

The price of beets in Poland has been raised considerably, in order to encourage the sowing of that crop, but so far information as to the area under beet in that country is lacking. The sowings of Holland and of Belgium will very probably be extended by 30 to 40 per cent., as a consequence of the high price for roots, and, as regards Holland, to the impossibility of exporting vegetables to Germany. The exchange value of the mark has fallen so low, that the German buyers cannot afford the price asked for Dutch horticultural products, and hence much land usually devoted to this cultivation has been turned over to beets.

A sugar scarcity in Sweden has so alarmed the Government that it has guaranteed a good price for sugar beets, unrestricted to the quantity grown. Now the beet growers, certain of an ample remuneration, are extending their sowings, so Sweden can look forward to a bigger production in 1920-21.

Though we foresee an improvement in the European sugar industry in the coming season, we are still very far from regaining the position which existed before the war. The continent will, taken as a whole, still require imports from other parts of the world for its very modest consumption, but the lowest depths of depression have certainly been reached and we hope that the year 1920-21 may be the first step towards a rapidly ascending output in the Continental beet sugar production.

The Economic Value of Antarctic Meteorology to Agriculturists.

(From a Correspondent).

Since the Expedition which Mr. John L. Cope, B.A., F.R.G.S., is about to lead to the Antarctic regions is of an up-to-date scientific nature, it is expected the result will be an early application of all the data of economic importance which are collected.

With constant communication by wireless, Australia, South Africa and South America will be materially assisted in forecasting the weather for months and even years ahead. The result of this in relation to agriculture, grazing, and all food production is of the greatest value. It is well known that drought, heat waves, frost, extensive rains, and floods are intimately related to antecedent meteorological conditions far removed from regions affected.

A comprehensive knowledge of simultaneous Antarctic conditions is absolutely necessary if the meteorology of the Southern Continents is to be usefully predicted, and so be of value to agriculture and aeronautics. Based on the observations of previous explorers we already have the ground work and a starting point for useful research, but such data only tend to prove the urgent need for a more comprehensive research, now made possible by the progress of science bringing about developments in aids to observation, such as the aeroplane, wireless telephony, sound ranges, etc.

The utility of meteorological investigations depends largely on co-operative effort, and to forecast the climatology of any region it is necessary to have knowledge outside the district under special consideration. Over the greater part of the tropical and temperate zones our knowledge of meteorological conditions is more or less complete, and practically accurate predictions of seasonal climatology are available for most countries within those areas. In Antarctica with the exception of some observations by the Argentine Republic, data have only been available from the records of Expeditions spending one or two seasons at intervals on the Antarctic continent or drifting in South Polar seas. Considering the wide areas involved and particularly Australia, these records are quite inadequate to give a comprehensive picture of normal conditions, and more complete investigation has become a necessity. For it is generally admitted that we must look to the polar regions for an explanation of the great variations from year to year in rainfall and temperature over the South Temperate zone where British agricultural interests are predominant.

Even with such incomplete information we already have, it has been possible to predict with comparative accuracy the probable seasonal rainfall of South America, the temperature of the South African plateau, the intensity of the Indian monsoon and the height of periodic floods, the forecasts being based on previous observations of atmospheric conditions in the Sub-antarctic and Antarctic regions. The probable conditions in Australia might also be anticipated if observatories were established in the Ross Sea area. With wireless communication, not only weekly predictions of comparative accuracy, but seasonal forecasts with practical certainty would be available.

Most scientific investigations, and particularly meteorological ones, have not in the past appealed to the practical man to whom accurate weather forecasts are of most importance, but to-day when a fair percentage of the men directly connected with agriculture have had a more or less scientific training and realise the value of chemistry and physics as applied to their concerns, it will not be hard to enlarge the already established fact that Sub-antarctic and Antarctic meteorology is of the utmost importance to all southern countries.

Mankind were slow to avail themselves of the advantages and conveniences of the products of scientific investigations; new-fangled notions were for those who could afford to sacrifice the surety of the well known methods of their forefathers, but now, when scientific research has produced such practical advances as "dry" farming, fertilizers, forced productions, telephones, wireless communication, aeroplanes, anti-toxin, X-rays, etc., it is easier to go one step further and take advantage of the knowledge of physical and meteorological conditions which may be collected by a few observers placed in remote regions.

In this age of necessary mass production, men, particularly food producers, cannot afford to waste their labour or to fail to take advantage of knowledge which would enable them to produce in greater quantity with greater ease. A reliable forecast of temperature and percentage of cloud, for instance, is of the utmost importance to those concerned with crops depending on the rise and fall of rivers. Cloud forms even failing to precipitate have a tremendous influence on such phenomena, affecting as they do the surface temperature and evaporation. How often has it been that sugar, corn, rice, and other planters have only half their areas planted when a season at first apparently normal develops into an extraordinary favourable one? And how often have many acres of crops been planted to flourish during a few weeks of apparently favourable weather, only to be blighted in the following weeks of drought?

To read the weather signs is no longer a speculation, it is an established fact, proved by observed relation between conditions in South America and those lower latitudes which show that the winter rains in Chile and the height of the rivers in Argentina depend on the height of the barometer in the Southern Pacific.

That some definite relation exists between McMurdo Sound, and Australia and New Zealand is shown by Dr. Simpson's observations while on Scott's last expedition. Thus 1903 the coldest year recorded at McMurdo Sound was a wet one in New South Wales and Victoria, while in 1912 the highest mean temperature in McMurdo Sound was characterized by drought in Australia. In June 1903 when the highest mean pressure (relative to the normal) was recorded in McMurdo Sound, Mr. H. A. Hunt, Commonwealth Meteorologist, reported in his "Rainfall of Queensland" with regard to June 1903: "A little rain fell over the southern districts, but totals were below the average generally (except on the 'Peninsular' north from Coen)."

Again in 1912 when the lowest mean pressure was recorded in McMurdo Sound he says with reference to Queensland: "Phenomenal rains fell, probably the heaviest rain experienced in the State. Totals were above the average throughout." Many other instances could be supplied, but data as yet cover too short a period to predict with certainty the relative conditions.

In conclusion we may express the hope that Australasia will certainly take advantage of the tremendously important knowledge of meteorological conditions to be collected by the British Imperial Antarctic Expedition as to be prepared to give the venture material assistance. The headquarters of the Expedition are at 66, Victoria Street, London, S.W. 1, to which address any communications or contributions should be directed.

The British Indian Sugar Industry.

Final General Memorandum of the 1919-20 Cane Crop.

An official Memorandum based on reports received from provinces containing 99 per cent. of the total area under cane cultivation in India was published on February 19th at Calcutta.

The total area sown is estimated at 2,667,000 acres as against 2,884,000 acres last year, or a decrease of 7 per cent. The total yield of raw sugar (*gur*) is estimated at 3,001,000 tons as against 2,370,000 tons last year, an increase of 27 per cent. The average yield per acre in lbs. worked out at 2,521 lbs. as compared with 1,841 lbs. in 1918-19. The season has on the whole been favourable to the crop. Details of the provinces are summarized below:—

United Provinces (*52·5 per cent.* of the total area under sugar cane in British India).—The total area sown amounts to 1,414,000 acres, as against 1,544,000 last year, showing a decrease of 8 per cent. The total yield of *gur* is estimated at 1,453,000 tons, as against 987,000 tons last year, or an increase of 47 per cent. The rainfall on the whole was deficient, November being practically rainless, so the yield was, in consequence, reduced to some extent as compared with the normal; and it is estimated at 90 per cent. as against 55 per cent. last year.

Punjab (*16·4 per cent.* of the total area under sugar cane in British India).—The area was finally returned at 480,000 acres, which is 1 per cent. above last year's area. The yield is estimated at 420,000 tons, which is 40 per cent. above that of last year. The season has been generally favourable. Heavy rains in July and August benefited the crop, and very little damage was caused by the subsequent scarcity of rain. The yield was normal or above normal everywhere.

Bihar and Orissa (*10·7 per cent.* of the total area under sugar cane in British India).—The total area planted is estimated at 297,000 acres (22,000 acres being in the Orissa and Chota Nagpur Feudatory States), which is almost the same as last year's area. The total yield is estimated at 330,000 tons (12,000 tons being in the Feudatory States), which is 17 per cent. above that of last year. The weather conditions have been generally favourable, though some damage was done by excessive rain and floods in places.

Bengal (*8·8 per cent.* of the total area under sugar cane in British India).—The area is estimated at 218,000 acres, as against 219,000 acres last year. The yield is estimated at 256,000 tons which is 15 per cent. above the yield of last year. Insufficient rainfall at planting time retarded germination in places, but subsequently up till September the weather conditions were generally good, although some damage was caused by excessive rain in parts of a few districts. The cyclone in Eastern Bengal did some harm to the crop in places. Lack of rain since the beginning of October has also tended to affect what was otherwise a good season.

The total quantity of raw sugar (*gur*) likely to be obtained from the juice of date palm is estimated at 101,000 tons as against 98,000 tons last year. The total quantity of *gur* in the province from all sources is thus estimated at 357,000 tons, as against 321,000 tons last year, or an increase of 11 per cent.

Madras (*4 per cent.* of the total area under sugar cane in British India).—The area planted is estimated at 91,000 acres, which is 26 per cent. below last year's area. The decrease is fairly general and is attributed to shortage of water at the planting season owing to the abnormally low rainfall in 1918. The high price of oilcakes and the deficiency of indigo refuse, which are the two chief manures for sugar cane, also tended to discourage cultivators from raising it. The yield is estimated at 261,000 tons, which is 8 per cent. above the yield of last year.

Bombay and Sind (*2·9 per cent.* of the total area under sugar cane in British India.)—The area is estimated at 77,000 acres (27,000 acres being in the Indian States excluding Baroda), which is 37 per cent. below last year's area. The decrease is due to the deficiency of water supply in wells and canals at the time of planting consequent on the drought of the previous year. The yield is estimated at 180,000 tons (57,000 tons being in the Indian States) which is 26 per cent. below the yield of last year.

Assam (*1·5 per cent* of the total area under sugar cane in British India).—The area is estimated at 31,000 acres, which is 6 per cent. below the area of last year. The yield is estimated at 28,000 tons, the same as that of last year. The weather conditions continued favourable after the issue of the first forecast. The rainfall from September to November encouraged the growth of the crop, and the outturn is estimated to be normal.

North-Western Frontier Province (*1·3 per cent.* of the total area under sugar cane in British India).—The area is estimated at 34,000 acres, which is 8 per cent. below the area of last year. The decrease is due to the lack of rain and insufficient water in the canals. The yield is estimated at 43,000 tons, which is 43 per cent. above last year's yield.

Central Provinces and Berar (*0·9 per cent.* of the total area under sugar cane in British India).—The area planted amounts to 22,000 acres (1,000 acres being in Berar), which is 27 per cent. below last year's area. The shrinkage is due to lack of water supplies. The yield is estimated at 26,000 tons (2,000 tons being in Berar), which is 7 per cent. below last year's yield. The seasonal conditions were, on the whole, generally favourable. The average outturn for the provinces as a whole is estimated at 109 per cent of the normal.

IMPORTS OF SUGAR INTO INDIA, APRIL TO MARCH.

Countries and Grade	1916-17 Tons.	1917-18 Tons.	1918-19 Tons.	1919-20 (10 months) Tons.
REFINED (16 D.S. AND ABOVE).				
Japan	11,575	4,459	402	741
Java	377,695	363,715	363,074	282,559
Mauritius	22,923	31,992	77,180	19,280
Austria-Hungary	..	35	..	..
Straits Settlements	14,770	61,012	62,130	16,915
China (including Hong-kong)	5,862	4,297	2,888	10,030
Egypt	230	1,316	853	2,673
Other countries	146	3,687	103	256
Total	433,201	470,513	506,530	332,454
UNREFINED (15 D.S. AND BELOW).				
Java	..	..	..	337
Philippines	6,900	..	..	..
Mauritius	20	155	..	..
Other countries	2	6	4	8
Total	6,922	161	4	345

Report on Labour Saving Devices in Field and Factory.[1]

By A. GARTLEY.

Being keenly alive to the value of any mechanical contrivance no matter how small whereby labour may be saved in any field or factory operation,[2] a Committee appointed by the Hawaiian Sugar Planters' Association sent a circular letter to managers of estates in Hawaii requesting particulars. Their replies are here briefly summarized.

Cane Cultivation.—Mr. JAMES GIBB, Honolulu Plantation Co., stated that he had found it possible to save labour by (1) adopting the contract system in place of day work, chiefly in cultivating and harvesting; (2) burning the cane before cutting; (3) installing the bonus system, which deters labour from moving from one place to another, since it stipulates working 20 days a month; (4) providing nurseries for children, so as to free women who otherwise would have to remain at home; (5) using tractors, instead of mule power, especially in furrowing, it being found that a 20 to 35 H.P. tractor can pull 2 furrow ploughs that on irrigated plantations usually require 16 mules; and (6) delivering the labourers to the fields in motor trucks.

Mr. JOHN A. SCOTT, Hilo Sugar Co., wrote that he considered the 45 H.P. Holt caterpillar tractor, to be one of the greatest labour saving devices that have been introduced into the territory during the past few years. It is capable of hauling a 28 in. four-disc gang plough over 8 to 10 acres per day. It can be used for harrowing, and covers a spread of 25 to 30 ft. It is also employed to split out the stools, using a home-made heavy four-disc plough with subsoiler attachment, thus separating the stools into six pieces so that the roots do not interfere with future cultivation.

He has also found the "Trundaar," a small tractor, of 20 H.P. at the drawbar, to prove a very serviceable machine after some slight changes. It has been used for ploughing, harrowing, off-barring, and hauling, making it possible further to dispense with mules for hauling the lime, sand, fertilizer, etc., from the stone roads through the fields. It does the work of four or six mules and in much less time.

After some modification the Avery stubble shaver has done very effective work, saving the labour of many men. It is worked by two mules, and passes over the row of stools, shaving off all projecting canes one or two inches below the surface, work which hitherto had been done by hoes. It covers four to five acres per day, more if the ground is fairly level; and it would take 20 to 30 men to do the same area. Moreover, it makes a clean cut, instead of shattering the stools as may happen when the operation is done by hoes.

Mr. JOHN T. MOIR, Onomea Sugar Co., has also adopted the stubble shaver, as well as a number of other devices on his estate. His opinion is that a great deal more can be accomplished with the machinery and tools on Hawaiian plantations if they were used to their full capacity. For example, he gives the following figures showing the work during 177 days in 1918 and 1919 respectively, in which latter year greater advantage had been taken of labour-saving appliances: cane ground, 151,273 and 167,104 tons; sugar made, 16,923 and 19,322 tons, the difference being 2,399 tons, or nearly one month's work.

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[1] Summary of a Report presented to the Hawaiian Sugar Planters' Association, 1919.

[2] *I.S.J.*, 1919, 182.

Milling.—Mr. WILLIAM SEARBY, American Factors, Ltd., reported that Messrs. KRAFFT and BOSSE of the Oahu Sugar Co. have been working on a novel method of handling the cane juice combined with the cush-cush as it comes from the rollers. The most approved system of maceration is to apply the entire amount of water to be used to the bagasse before it enters the last mill of the train. The last juice expressed by the mill on account of all the water being applied at this point is very dilute, and this dilute juice is returned to the bagasse in front of the mill next to the last mill. The juice obtained from this mill is returned to the mill in front of it, the juice from the first mill and crusher only going direct to the clarification house. It is in handling this returned juice, and in obviating the necessity of separating the cush-cush from the returned juice, that this scheme has merit as a labour-saving device. It does away with all the moving parts now employed in juice screening, except a pump, the discharge from which is delivered on a distributor plate over the intermediate carriers between the mills spreading the diluted juice and the cush-cush evenly over the carrier.

It is right to say, however, that this scheme has met with only partial success, the obstacle to better results being the lack of a suitable pump. Several trials have now been made with a pump that promises the solution to the difficulty of lifting the mixture of juice and cush-cush. If this really is so, the method will prove a labour-saving one, the advantages of which will be obvious to all mill men.

Another labour saving device worthy of note is a device for the automatic regulation of the maceration water applied to the mills. It is the invention of Mr. AUGUST KRUSE,[1] of Waimea, Kauai, and uses the rise and fall of the top roller to operate a valve controlling the maceration water. It is a very simple arrangement, which, when once adjusted, works without any attention on the part of the operator, and applies a very uniform amount of maceration water, no matter to what extent the thickness of the blanket may vary when going between the rollers.

Mr. SEARBY has also found the installation of travelling bridge cranes to prove great time and labour savers in the mills under his control, when it is required to change rollers and make repairs. Mr. F. F. BALDWIN, Hawaiian Commercial and Sugar Co., reports a similar result. He uses 15-ton electric cranes, and in consequence is able to dispense with the services of 10 men.

Clarification.—Mr. BALDWIN also stated that he had converted his mud settlers from the intermittent to the continuous type, similar in operation to the apparatus of Colonial Sugar Refining Co., of Australia.[2] Two men have thus been eliminated at this station, while the character of the work has improved.

Centrifugals.—Mr. F. M. ANDERSON, Paauhau Sugar Plantation Co., wrote that by installing four 40 in. machines in place of six 30 in. centrifugals he had eliminated one man every 12-hour shift. By installing a number of re-melting tanks and conveyors for the handling of the different grades of sugars under the centrifugals, Mr. BALDWIN had been able to dispense with 12 men. Mr. JOHN T. MOIR, Onomea Sugar Co., said that formerly his low grades had to be dried, bagged, and elevated to the vacuum pan floor, whereas now they are handled by dropping them from the centrifugals into a mixer and working them along to a pump, which raises them to the desired place.

Lastly, Mr. JAMES GIBB, said that he was now using compressed air in place of manual labour for cleaning his effects and boilers, and for doing much of the general repair work in his machine shops.

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[1] Patent applied for, which should be issued shortly.

[2] *I.S.J.*, 1919, 246; 1920, 231.

Fifty Years Ago.

From the "Sugar Cane," May, 1870.

Most of the articles contained in this issue were of ephemeral interest only. One that is worth of mention, however, dealt with some early experiments upon the application of the diffusion process to the extraction of sugar from the cane. These experiments had taken place at the Aska Sugar Works, Madras, India, and some details are given from the report upon them by one FERDINAND KOHN, who at that time was engineer to this firm. Four cutting machines dealing with 70 tons of cane per day, and ten diffusion vessels, had been installed. Few chemical data were given, and there appears to have been no difference between the purity of the diffusion juice and that obtained from the mills. An extraction of 95·4 per cent. of the sugar in the cane was realized; and it was concluded that "the diffusion process is therefore capable of increasing the yield of the cane by 13 per cent., when compared with the very best practice of modern cane mills, and to increase the yield by 12 per cent. when compared with the average working of sugar mills in the greater number of sugar growing countries and colonies." The dilution was 20 per cent. This German writer made the statement that the labour required in the whole process of diffusion was not greater than in mills crushing the same amount of cane, and also that the cane slices after extraction had the same value for fuel as the ordinary bagasse. He admitted, however, that the process was less expeditious than milling, and that the quantity of water required was considerable, which latter disadvantage alone would prevent its adoption in some countries.

WILLIAM ARNOT continued his "Notes from the Laboratory of a Sugar Refiner," dealing in this article with the "diseases" to which animal charcoal had been found by him to be subject under the conditions of working in those days. Deficiency of carbon was explained by him to be due to the obvious cause of oxidation, arising from faulty joints or slides admitting air into the kilns or coolers; or it might result from re-burning being conducted at too high a temperature, or again from the use of sugars containing a high proportion of sulphates or sulphites. Excess of carbon, on the other hand, was to be traced to insufficient washing, or to the use of water containing organic matter. Accumulation of iron oxide, a serious defect, was attributed to the action of sour washings on tanks, pipes, moulds, etc., and to a thorough system of painting with the avoidance of acid liquors as far as practicable was recommended. A high content of lime in the char was regarded as another "disease," and for dealing with this irregularity "a more ingenious and trustworthy process than that of Beane's could not well be devised." Beane's process[1] consisted in treating the char with hydrochloric acid gas, whereby the calcium carbonate content could readily be reduced. Lastly this writer mentioned that at the time when he wrote refiners were using very low beet sugars containing a high proportion of sodium sulphate and chloride, the action of which salts on the char (unless very thorough washing was practised) was found to be very objectionable, since being fusible they coated the grains. It was urged, therefore, to avoid as far as possible such troublesome sugars.

Several patents were noticed in this issue, three of which may be mentioned. A. SEYFERTH,[2] of Brunswick, protected a process of purifying sugar syrups by treating them in the vacuum pan with either dilute sulphurous acid or else sulphurous acid gas. 100 parts of a syrup at 28 to 32° Bé. (51·5 to 60° Brix) and 1 to 1½ parts of sulphurous acid gas (as such, or in solution) were mixed together in the pan, and concentrated to graining point, the excess of the acid being eliminated during the process of concentration. As the result, it was claimed, the syrup was improved in taste to an extent that cannot be obtained by applying great quantities of animal charcoal. M. ICERY, of Mauritius,[1] disclosed particulars of his apparatus "for producing quickly and economically sulphurous acid and sulphites by the combustion of raw sulphur," to which process allusion has already been made.[2] M. MARTIN[3] claimed the use of aluminium fluoride for the clarification of sugar juices. Previous to adding this salt, 2 to 3 per cent. of a solution of potassium hydroxide was mixed with the juice, the result being that potassium, sodium, and calcium hydrofluoaluminates, are formed, and also aluminium hydroxide, which reactions were said to effect a consideable decolorization.

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[1] English Patent, 283 of 1964.

[2] English Patent, 2756 of 1869.

Chemical Control Results of Java Factories, 1919.

Below are given the average results of mill data for 1919 obtained from 142 Java sugar factories working under the Mutual Control, data regarding which are annually collated by the Java Sugar Experiment Station.[4]

		Defecation.	Defecation-sulphitation.	Carbonatation.
Cane ground, piculs		1,251,119	1,278,896	1,364,987
Cane ground, long tons		76,050	77,738	82,972
Sucrose in mixed juice, per 100 cane		11·19	11·50	11·82
Sucrose per 100 sucrose of mixed juice.	Press-cake	0·8	1·0	0·4
	Sugars	87·8	86·9	88·9
	Exhausted molasses	9·1	9 6	7·8
	Undetermined losses	2·2	2·5	2·9
Weight per 100 of cane.	Mixed juice	87·82	87·52	87·48
	Press-cake	1·74	2·02*	5·98
	Exhausted molasses	3·04	3·29	2·83
	Plantation white sugar	—	9·61	9·70
	Sugar of 16–20 D.S.	4·92	—	—
	Sugar of 14 D S.	4·96	—	—
	Second boilings	—	0·29	0·66
	Molasses sugar	0·11	0·09	0·12
	Black stroop	0·05	0·04	0·09
	Total, as standard muscovado	10·24	10 49	11·02
	Standard muscovado, by Geerligs' formula	10·38	10·70	11·06
	Efficiency	98·7	97·9	99·6
Recovered crystals in sugars		87·0	86·8	88·7
Calculated crystal, per 100 sucrose of mixed juice		89·1	89·4	91·4
Efficiency		97·6	97·1	97·0
Cane	Polarization	12·15	12·49	12·84
	Fibre	12·98	13·06	12·99
Bagasse	Polarization	4·04	3·95	4·06
	Solids	52·89	52·98	53·36
	Fibre	47·43	47·79	47·79
Mixed juice	Brix	15·29	15·68	16·02
	Sucrose	12·75	13·13	13·51
	Purity, apparent	83·3	83·8	84·3
	Polarization	12·56	12·99	13·36
	Reducing sugars	1·13	1·11	1·03

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[1] French Patent, 85,493 of 1869. [2] *I.S.J.*, 1920, 71. [3] French Patent, 87,186 of 1869. [4] *I.S.J.*, 1919, 493-4. * Press-cake (syrup) 0·05.

		Defecation.	Defecation-sulphitation.	Carbonatation.
Press-cake.	Polarization	5·25	5·38*	0·79
	Solids	37·68	37·93†	51·52
Clarified juice..	Brix	16·36	16·94	13·93
	Sucrose	13·91	14·41	12·12
	Purity, apparent	85·0	85·1	87·0
	Polarization	13·71	14·27	11·98
Syrup	Brix	55·75	54·04	54·93
	Sucrose	47·57	46·21	48·05
	Purity, apparent	85·3	85·8	87·3
	Polarization	47·10	45·96	47·43
First boiling.	Brix	91·94	92·32	92·79
	Purity, apparent	84·0	84·2	84·7
Purity of first green molasses		64·5	65·1	65 8
Second boilings.	Brix	92·97	93·44	93·68
	Purity, apparent	77·6	77·1	76·4
Purity of second green molasses		57·5	56·7	55·5
Third boilings.	Brix	94·52	94·72	95·23
	Purity, apparent	69·0	69·1	70·3
Purity of third green molasses		49 5	48·4	47·2
Fourth boilings.	Brix	99·96	97·79	96·98
	Purity, apparent	59·4	59·8	57·4
Plantation white sugars.	Brix	99·90	99 96	99·93
	Sucrose	99·80	99·83	99·82
	Polarization	99 60	99·61	99·59
Refining sugars, 16-20 D.S.	Brix	99·75	—	—
	Sucrose	98·68	—	—
	Polarization	98·42	—	—
Refining sugars, 14 D.S.	Brix	99·59	—	—
	Sucrose	97·63	—	—
	Polarization	97·33	—	—
Second boilings.	Brix	—	99·32	99·30
	Sucrose	—	98·62	98·59
	Polarization	—	98·39	98·27
Molasses sugars..	Brix	97·81	98·23	98·73
	Sucrose	86·61	87·79	88·10
	Polarization	85·76	86·91	87·81
Black stroop sugars..	Brix	96·63	95·08	98·70
	Sucrose	82·23	82·51	83·96
	Polarization	81·88	81·57	83·36
Exhausted molasses.	Brix	91·93	93·02	91·67
	Sucrose	33·62	33·32	32·74
	Purity, apparent	36·6	35·8	35·7
	Polarization	29·48	29·82	30·11
	Purity	32·1	32·1	32·9
	Reducing sugars	27·65	28·39	25·76
	Ash	9·96	9·59	9·22

The Sena Sugar Estates, Limited, has been registered under the English Companies Acts, with a share capital of £1,500,000 and a debenture capital of £260,000, to acquire the business of the Sena Sugar Factory Limited, as well as the sugar plantations and factories held jointly by that company and HORNUNG & Co., Limited. Messrs. HORNUNG & Co., Ltd., have been appointed general managers and secretaries of the company at their London address, Laurence Pountney Hill, E.C.4.

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* Press-cake (syrup) 3·60. † Press-cake (syrup) 47·75.

American Commerce Reports.[1]

The Java Sugar Industry.

In some trade quarters it is not generally realized that Java is the third largest sugar-producing country in the world, ranking next to Cuba and British India. As the latter consumes all that it produces, Java ranks next to Cuba in sugar exports, actual production being about half of the Cuban output and approximately three times the production of the Hawaiian Islands. Compared with the Hawaiian industry, where there are about 50 sugar centrals, Java has at present 186 producing mills with an average investment in plants or mills of from $300,000 to $500,000 each, or an aggregate very roughly estimated, of something like $75,000,000, of which business America has had in the past a very small share. The industry in Java is older than that of Hawaii, and will probably not be much increased in the future, owing to the difficulty in securing further tracts of sugar land.

Due to the density of population in Java, estimated now to be more than 30,000,000, the Government does not permit of large concessions of land and will allow the use of any given tract of land for sugar production for only one year out of three, requiring that rice be planted for two years of the three. This necessitates a rotation of crops in three-year periods and continually reserves two-thirds of the available sugar land for the production of rice. This has been found to be a very wise provision, since even under the present system, the consumption of rice is greater than the production in Java in normal years, so that the country is somewhat dependent on the near-by rice producing countries for imports of the staple food supply. During the past year there was, in fact, considerable discussion looking toward the further restriction by Government of sugar cultivation in order that the local rice production might be increased. This proposal was eventually abandoned, however, in view of the importance and value of the sugar crop at the present time of great world demand and consequent high prices.

The sugar mills are for the most part large, modern plants, although some of the labour-saving devices in common use in many other countries are not used owing to cheap and plentiful labour. There is now, however, a growing interest in labour-saving appliances and machinery, due to the increased cost of labour and a certain amount of labour trouble which seems to be prevalent to-day in Java as well as other parts of the world. Java sugar growers are now, for the first time, coming to a realization of their rather precarious situation in depending so completely on unskilled labour.

It would appear that the time for the introduction of labour-saving machinery is rapidly approaching, and careful and systematic efforts by manufacturers in this direction should bring results during the next few years. Most of the estates are supplied with light railways operated with small light cars, but many still rely largely on bullock carts for bringing the cane to the mills and native labour in handling it. Many estates use small cars on the light railways, either pushed by hand or drawn by bullocks, while only a few have locomotive equipment.

The transportation of cane is especially difficult here, because of the fact, above mentioned, that planted areas are in small plats interspersed with plots of rice paddy, so that a plantation of 2,000 acres of cane is compelled to extend its transportation system over territory of three or four times that amount of land. Figuratively speaking, a plantation of 4 square miles of cane, where the longest haul would be about a mile if the mill were placed in the centre of a compact tract of that size, would require a long haul of more than 2 miles if only a third or fourth of the land is in cane. Actually the difference is in many cases considerably greater than in the above hypothetical case, since the plats are not arranged with mathematical precision. A certain plantation, for example, of approximately 4,000 acres under cultivation must haul the cane about 8 miles from some of its more distant fields. Since the plats are changed from year to year, much of the light railway must be portable.

It is understood that the machinery and equipment of many of the mills has not been maintained in first-class condition during the past few years, owing to the impossibility of securing supplies from their former European connexions, although a small amount of minor supplies has been obtainable from America. Since the Dutch East Indies and America are now for the first time really becoming acquainted with each other, considerable interest is being shown in American machinery and iron and steel products. Such materials must, in the near future, compete with European products and will be at a disadvantage in competition with them in dealing with customers who have definite knowledge of the utility and value of the latter, with which they have always worked. Americans, to successfully enter the field, must have a thorough knowledge of local conditions and must be prepared to prove to their prospective customers here that their goods are better, all things considered, than can be secured elswhere.—[U.S. Consular Report.]

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[1] Culled from "Commerce Reports," published by the Department of Commerce, Washington. In many cases these are abbreviated here.

SPRAYING OUTFITS RECOMMENDED FOR TRINIDAD.

A pamphlet giving details as to spraying outfits required in Trinidad in connexion with the cacao industry has lately been issued by Mr. F. W. URICH, Entomologist of the Board of Agriculture of the Trinidad Government.

Mr. URICH recommends as spraying outfits for small estates a type of small hand pump, with agitator, delivery tube, and air chamber, also bamboo spray rod 10 to 12 ft. long, stopcock for rod, and angle nozzle with hole one-tenth inch in diameter, and one 25 to 50 ft. length of hose with ½ in. bore. The pump may be mounted on a 10-gallon iron drum. Mr. URICH explains that such an outfit is self-contained, light, and easy to use on hilly as well as flat lands. He says that all barrel pumps should be provided with agitators, and that as handles of pumps are frequently broken by carelessness in pumping, spare handles should always be at hand. The pre-war cost of such outfits was from $20 to $50, according to size of pump and number of leads of hose on barrel or drum.

Mr. URICH recommends as spraying outfit for large estates a double-action pump mounted on a small platform for carrying about, two bamboo spray rods, 10 to 12 ft. long, two stopcocks for rods, two angle nozzles with hole one-sixteenth of an inch in diam., two lengths of hose of half-inch bore, each 50 ft. long. He states that any size of tank, barrel or drum may be used for the spray liquid, the size being regulated by the nature of the district. The pump should give good pressure, and when suitable Y pieces are used four leads of hose can be employed, but a slight fault is that the agitation of the spray liquid has to be done by hand.

Mr. URICH, in his pamphlet, explains that strainers are one of the most important parts of any outfit, and the better a liquor for spraying is strained the better the pump will work and the longer it will last. All solutions should be strained twice: First, when they are being mixed, and, second, before they are poured into the spray tank, barrel, or drum. Careless straining means clogged nozzles and delay in work. A good strainer can be made out of any oblong box, the sides of which should be sloping. The wire cloth forming the bottom of the strainer should be fastened at the angle, so as to allow the liquids to pass through better. The wire cloth should preferably be of brass, and the meshes should always be 20 to the inch. Only the best rubber hose, specially made for spraying, should be used. Ordinary garden hose should never be used, as it will not stand the pressure required for spraying. Couplings having hexagonal nuts are the only ones to use, so that an ordinary shifting spanner can turn them. Rubber or leather washers should be employed in all connexions and couplings.

The rods used for spraying, Mr. URICH says, are generally made of brass or copper tubing with a bamboo covering. It is important that the tube be well secured in the bamboo rod, so that it does not turn when the fittings are being screwed up. The length of a rod should not exceed 12 ft. for average spraying on cacao estates. Longer rods are too heavy, and when the trees are very tall it is better to use ladders, as is sometimes done for pruning.

Stopcocks are very important, as their use saves the spraying mixture when the outfit is being moved from tree to tree. An angle nozzle is the best kind for directing the spray to the underside of leaves, where most of the thrips occur. The hole in the disc should not exceed one-sixteenth of an inch in diameter; after long use the hole is apt to wear larger, when a new disc must be substituted. It is useful to have a pair of pliers, and also a shifting spanner, in connexion with spraying.—[Consular Report, January 9th, 1920.]

Formosa.

Sugar Industry Developments.

(British Consular Report.)

The present sugar season in Formosa has been somewhat late in opening owing to shortage of coal at the mills caused by the inadequacy of transport facilities. One or two companies commenced the manufacture of sugar in December, but the majority did not make a start until well on in January. The sugar crop was so seriously diminished by the violent typhoon which swept over the Island late in August last that it was estimated the output of centrifugals would not exceed 4,380,000 piculs. Even this figure has, however, proved too optimistic, as the weather since August has been unfavourable, and recent forecasts do not put the production of centrifugals at more than 3,800,000 piculs (226,200 long tons), and that of brown sugars at 400,000 piculs (23,800 long tons). These figures indicate a serious falling off as compared with the 1918-19 season, the production of which amounted to 4,428,742 piculs (263,564 long tons) of centrifugals and 500,000 piculs (29,761 long tons) of browns.

The area under sugar cane, which was 258,325 acres in 1918-19, has decreased to 236,269 acres in the present year. This decrease is directly due to the high price of rice, which renders it a more profitable crop for the farmers. According to the local press, however, there is every indication that a larger acreage will be put under sugar for the 1920-21 season. The various new companies recently established have to find cane for their mills, and they are offering every inducement to persuade the Formosan farmers to grow cane instead of rice.

The fact that no great anxiety is entertained regarding the future of the industry is evidenced by the large number of new sugar companies which were established during the past year. The most important of these, with their capital, were as follows:—

Company.	Capital. Yen.
Japanese Development Co., Ltd.	10,000,000
Shinchiku Sugar Manufacturing Co., Ltd.	7,500,000
Yamato Sugar Manufacturing Co., Ltd.	5,000,000
Asahi Sugar Manufacturing Co., Ltd.	3,500,000
Taichu Sugar Manufacturing Co., Ltd.	3,000,000
Takasago Sugar Manufacturing and Industrial Co., Ltd.	1,500,000
Ako Development Co., Ltd.	1,000,000

Another new sugar company, to be known as the Teitai Sugar Manufacturing Co., Ltd., is to be established with a capital of 1,000,000 yen; while it is reported that the Ensuiko Sugar Manufacturing and Development Company is increasing its authorized capital by 13,750,000 yen to 25,000,000 yen.

An interesting feature is the attention paid by Formosan sugar companies and Japanese capitalists to sugar production in the Netherlands East Indies and elsewhere in the South Seas. The Niitaka Sugar Company recently increased its capital of 5,000,000 yen to 10,000,000 yen, one of the objects being to engage in the cultivation of sugar, rubber, and copra in Java. The Taiwan Sugar Manufacturing Company, the largest in the island, is reported to be now contemplating the establishment of a branch office at Rangoon in order to carry on sugar and rubber production. Probably the most important development in this direction is the formation of a company to be known as the Japanese and Foreign Sugar Manufacturing Co., Ltd. (Naigai Seito Kabushiki Kaisha), with an authorized capital of 10,000,000 yen. The object of this undertaking is the cultivation and manufacture of sugar in Java, where a large Dutch company has been bought out. The Naigai Company are to pay 2,500,000 yen, and to put 1,000,000 yen aside for ordinary running expenses. These charges will be met with the paid-up capital of 2,500,000 yen, and debentures for 1,000,000 yen. The income is estimated at 2,425,000 yen, and the expenditure at 1,140,000 yen, including an allowance of 480,000 yen to meet the expected tax of the Netherlands East Indian Government on exported sugar, mentioned below.

An entirely new departure, dating from the commencement of 1919, has been the importation to Formosa of Java sugar for re-manufacture in Formosa during the slack season. These imports during the first year of this movement amounted to no less than 74,577,217 kin, valued at 15,502,157 yen.

The Government of the Netherlands East Indies is, it is reported, about to impose an export duty of 4·80 yen per picul on sugar. It will be interesting to observe how this duty, if imposed, will affect the recent tendency to import Java sugar for re-manufacture at the mills in this island.

Publications Received.

Industrial Uses of Fuel Oil. By F. B. Dunn. (Technical Publishing Coy., San Francisco.) 1916.

The author claims that this book has been written by a practical man for the use of practical men, and a perusal of its pages amply confirms this. In these days when the use of liquid fuel is increasing and its value is well recognized a book such as this cannot fail to be of interest. The author principally confines himself to a consideration of the use of oils in furnaces where high temperatures are required, and for steam raising with various types of boilers, but the subject of the application of liquid fuel in internal combustion engines is not dealt with. Being American in its origin, it is natural that this book should treat mostly of the use of native oils either in a crude or refined state. After giving a comparison of various grades of oils, and stating their economic value against coal, while presenting some important figures and tables, the question of oil storage, pumping, and boiler furnace arrangement is dealt with. A very important point in the use of oil as a fuel is its straining from foreign impurities and the actual type of burner used in the combustion of the oil. Two chapters are devoted to this.

Among the many examples given of the application of fuel oil in industry, our readers will turn with most interest to the section on the use of oil as fuel in sugar manufacture. Unfortunately this subject is treated with brevity. The statement is made that planters would find it necessary to make radical changes in their plant equipment in order to take full advantage of modern improvements in furnaces designed to burn bagasse. "Fuel oil came on the market and *owing to its low cost* was most welcome to the planter." The words italicised surely express the crux of the matter. There is no doubt that the application of fuel oil in the sugar industry, as in other industries, resolves itself into a question of locality and price. From the figures given, the quantity of oil used may vary from 1½ gallons to as much as 10 gallons in Mexico, per ton of cane treated.

The book has many illustrations, diagrams, tables, and data of results of much interest, and the portions on Furnace Efficiency and Tests and Reports are expressed with great clearness and with much detail.

Publications Received.

Memorandum on Solid Lubricants. Bulletin No. 4, Department of Industrial and Scientific Research. (H.M. Stationery Office, Imperial House, Kingsway, W.C. 2.) Price: 6d. net. 1920.

In 1917 the Lubricants and Lubrication Enquiry Committee was appointed to survey the field for research, and in the course of their work dealt with the question of solid lubricants. They have now prepared a Memorandum which is intended to be regarded rather as a summary of existing literature than as an authoritative statement based upon actual research. Among the matters discussed are: the characteristics and action of solid lubricants; analyses and grading of lubricating graphites; hot bearings; methods of application; and observations on some results obtained.

Volumetric Tests on Scientific Glass-Ware. (National Physical Laboratory, Teddington, Middlesex).

A new building has been completed at the National Physical Laboratory for the testing of scientific glassware, and a bulletin is now issued in co-operation with users and manufacturers of such apparatus containing regulations relating to this work. The tests are divided into two classes, A and B, the first being for vessels intended to attain the highest accuracy required for scientific work, and the second for those designed to possess "commercial accuracy" only. The tolerances allowed in a few typical examples given in the bulletin are for the two classes respectively[1]: 100 c.c. pipette, ±0·05 and ±0·08 c.c.; 100 c.c. flask, ±0·05 and ±0·10 c.c.; 50 c.c. burette, ±0·04 and ±0·07 c.c.

A Prelimininary Note on the Behaviour in North India of the Firs Batch of Sugar Cane Seedlings distributed from the Sugar Breeding Station, Coimbatore. By T. S. Venkatraman, B.A., Actingt Government Sugar Cane Expert, Madras. Bulletin No. 94 of the Agricultural Research Institute, Pusa, Bengal. (Calcutta: Superintendent Government Printing. Price, 8 Annas.)

Second Hundred Notes on Indian Insects. Bulletin No. 89, Agricultural Research Institute, Pusa, Bengal. Compiled by T. Bainbrigge Fletcher, Imperial Entomologist, Pusa. 58 figures. (Calcutta: Superintendent Government Printing. Price, 2s.)

Report on the Progress of Agriculture in India for 1918-19. 186 pp. (Calcutta: Superintendent Government Printing. Price, 2s.)

Monthly Notes on Grubs and other Cane Pests (Second Series). By J. F. Illingworth. 1918-19. Bulletin No. 8, Division of Entomology, Queensland Bureau of Sugar Experiment Stations. 51 pp.

In view of the expression of opinion by Sir Auckland Geddes, till lately President of the Board of Trade, regarding the acceptance of advertisements of goods manufactured in late enemy countries, the Council of the British Association of Trade and Technical Journals (to which Association belong some 200 of the British trade and technical press organs) have carefully considered the whole position. They have now recommended members to adhere to the adopted policy of the Association not to accept such advertisements for the present, in order to enable British manufacturers to recover their normal working conditions. At the end of 1920 the subject will again come up for consideration.

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[1] See also Circular of the Bureau of Standards, No. 9; *I.S.J.*, 1914, 482.

Correspondence.

CANE NOMENCLATURE IN ARGENTINA.

To the Editor, "The International Sugar Journal."

Sir,—In an article entitled "Agricultural Notes" in the February issue of your journal, your contributor refers to the nomenclature of canes in this country. He quotes from a Porto Rico bulletin the statement that the J.36 cane of the Argentine is not the original J.36 of Java, and indicates that the Tucumán Station should clear up the mystery. In reply to this I would state that the matter was cleared up by this station a considerable time ago (see "Revista Industrial y Agricola de Tucumán," Vol. VIII., pp. 195-214, Feb., 1918). In this article it was shown that the only cane known as J.36 in the Argentine is the POJ.36 of Java, and (incidentally) that the other Java seedlings in common cultivation in this country (POJ.213 and 228) are correctly named.

The detailed descriptions of the Kavangire (Uba), Zwinga, and Yon Tan San for which your contributor asks were also published a year ago in the same journal (Feb.-Mar., 1919, p. 129).

I do not know why the J.36 should have acquired the name J.56 in Porto Rico. As however, I am not acquainted with any Java seedling of that number, and as we undoubtedly sent some Java seedlings to that country in 1915, it would appear that, through, the misreading of a label perhaps, what they refer to as J.56 is the POJ.36 from Tucumán.

As to the origin of the "Japanese" canes in Tucumán, the Kavangire cane was obtained by us from the Escuela Nacional de Agricultura de Tucumán in 1908, they having obtained it on their part in 1907 from the Experiment Station at Campinas, Brazil, We obtained from the same source at the same time two other varieties, the *Bambu de Tabandi* and the *Sin Nombre 54*. This latter cane was one whose label had been lost in transit between the Brazilian and the Tucumán institution, and for that reason given the designation *No. 54 Nameless* (to translate the Spanish). The three canes mentioned were extremely similar in their appearance and habits of growth, and when Mr. G. L. Fawcett took up the botanical study of our varieties he was able to show definitely that they were one and the same cane.

The Zwinga cane was imported by this station directly from Louisiana, where it is a well-known variety.

The Yon Tan San was imported by this station directly from Formosa, being kindly sent us by the Department of Productive Industries of the Government of Formosa. It is described by them as a hardy cane, "improved in Lioo Choo Island, giving heavy crop even in poor soil."

I am afraid I cannot agree with your contributor when he says that it appears improbable that the Kavangire came from Japan, as in spite of the lack of indigenous varieties in that country, it is a notable fact that other canes of this same type *have* reached the American continent from Japan. The Zwinga, according to Dr. W. C. Stubbs ("Sugar Cane," p. 64, 68) was imported into Louisiana by Commissioner of Agriculture Leduc from Japan. Dr. Stubbs says of this cane, "Its origin is unknown, as no mention of this variety occurs in any writings on sugar cane, and is perhaps *not cultivated elsewhere than in Japan.*" The Yon Tan San, as we have said, was sent to us directly from Formosa, by the Japanese Government authorities there. Accompanying this cane was another variety, bearing the name Tek Chah, described in their letter as "old cultivated variety, stand to storm, pest and insect damages," which unfortunately did not germinate here, but which was undoubtedly of the same type of cane as the Kavangire and the Zwinga. These canes, it may be said, were sent to us in response to a request that they send canes which would be likely to do well in this region; from the correspondence I should assume that they represent the old type of cane cultivated in Formosa before the Rose Bamboo was adopted as the standard cane of the industry. Dr. H. C. Prinsen Geerligs in his book on "The World's Cane Sugar Industry" states that "the species of cane that was mostly cultivated (in Formosa) was a green variety that yielded little juice, but which had the advantage over the red type of never dying off, however much it was neglected." Both these points would indicate the Kavangire type;

the hardness and high fibre-content of these canes mean a poor juice extraction, especially in a primitive mill; the "never dying off" probably means that the stubbles were very resistent to root disease, of which, according to many, the so-called Mosaic disease is only a manifestation.

I do not think, however, that our Japanese canes have the same names in Japan as here, as we have recently received a request from the Japanese authorities in Taihoku to send them both the Zwinga and the Kavangire.

Yours very truly,
WM. E. CROSS, Director.

Estacion Experimental Agricola,
Tucumán, Argentina.

Chemical Control Results of some Cuban Factories, 1919.

The following figures have been sent us by a correspondent as illustrating chemical control results of some Cuban factories during 1919. At the same time since there is no "mutual control" among these factories, like is the case in Java, the figures are not strictly comparable and can only be taken as some indication of typical results.

	Extraction.	Maceration.	Cane.		Sucrose in Bagasse, per cent.	Sucrose extracted.	Sucrose in Juice, per cent. Sucrose in Cane.	Sucrose in Sugars, per cent. Sucrose in Juice.
			Sucrose.	Fibre.				
1.	80·97	17·37	10·93	10·48	3·01	10·28	94·04	88·19
2.	79·82	12·83	12·23	10 17	4·31	11·25	91·98	92·48
3.	80·64	18·90	11·85	10·34	3·58	11·04	93 17	88·04
4.	83·75	22·68	13·63	9·30	3·39	12·94	94·92	90·15
5.	77·26	17·60	12·67	10·90	4·24	11·60	91·55	89·40
6.	75·29	8·60	12·93	11·30	3·86	11·94	92·34	91·54
7.	78·08	16·58	13·53	11·60	4·18	12·50	92·42	91·39
8.	79·50	17·10	13·27	11·33	4·39	12·17	91·71	90·96
9.	77·20	16·51	12·42	11·20	4·56	11·38	91·62	89·71
10.	79·88	15·23	13·09	10·55	4·23	12·11	92 52	89·48
11.	75·76	15·72	13·24	11·03	5·72	11·72	88·49	88·76
12.	74·75	5·78	13·15	11·30	6·52	11·45	87·07	92·13
13.	79·57	14·30	12·96	11·26	5·18	11·70	90·28	91·29

	Sucrose in Sugars, per cent. Sucrose in Cane.	Yield 96° Sugar.	Normal Juice.		Final Molasses.		Tons Cane Ground per hour.
			Sucrose.	Purity.	Purity.	per cent. Cane.	
1.	82·93	9·44	12·69	80·45	33·64	3·49	112
2.	85·06	10·83	14·09	82·38	32·85	2·67	60·2
3.	82·03	10·25	13·69	80·08	34·97	3·65	58
4.	85·57	12·12	15·45	82·40	35·81	3·57	62
5.	82·00	10·77	15·17	82·40	29·93	3·10	105
6.	84·53	11·38	15·86	83·33	29·04	3·04	52
7.	84·40	11·92	15·30	84·10	31·30	3·40	115
8.	83·42	11·53	15·31	84·58	34·09	2·80	63
9.	82·20	10·63	14·75	81·76	30·20	3·70	84
10.	82·73	11·28	15·16	83·85	37·13	3·44	62
11.	78·54	10·81	15·50	84·00	37·50	3·06	59
12.	80·10	10·99	15·80	84·50	35·30	2·50	75
13.	82·35	11·12	14·71	81·90	29·60	3·40	68

Brevities.

The price of U.K. patent specifications has been raised to 1s. each, post free; that of the U.S. specification is now 10 cents., post free.

"Norit" decolorizing carbon, which at present is manufactured in Holland by a process the details of which are kept secret, will, it is stated, shortly be produced in Louisiana.

Dr. E. F. Armstrong, author of "The Simple Carbohydrates and the Glucosides," the third edition of which was recently published,[1] and an investigator of the first rank on problems connected with the chemistry of the carbohydrates, has been honoured by being elected a Fellow of the Royal Society of London.

Among recent company changes of sugar businesses are to be noted the converting of Messrs. Macfie & Sons, the well known Liverpool sugar refiners, into a private limited liability company; and the transfer of the business of the Antigua Sugar Factory to a limited company of the same name, the purchase consideration being £170,968 in shares. The offices of the latter company remain as heretofore at 18, Laurence Pountney Lane, London, E.C. 4.

The Commonwealth of Australia has lately revised its Customs Tariff; the new scale in many instances shows three different rates—a British Preferential Tariff, an Intermediate, and a General Tariff. With regard to sugar, however, no distinction is shown in the three classes and the duties are, per cwt.; Glucose, 8s.; Cane Sugar, 6s.; Invert Sugar and Invert Syrup, 6s.; Sugar, not elsewhere included, 10s.; Golden Syrups and Sugar Syrups, not elsewhere included, 3s.; while Glucose is admitted free. The tariff therefore differentiates against beet sugar to the extent of £4 per ton.

Dr. F. W. Zerban, formerly chemist on the staff of the Louisiana Sugar Experiment Station, has been appointed research chemist to Messrs. Penick & Ford, Ltd., of New Orleans, the well-known firm dealing in molasses and syrups. Dr. Zerban has recently carried out some particularly interesting investigations on the colouring substances of cane products,[2] and also upon the production of decolorizing carbons,[3] and his appointment should prove a decided acquisition to this progressive business.

An Information Circular of the U.S. Department of Agriculture states that as the result of an investigation into substitute sugars it has found maltose to be the most promising. National prohibition allows a considerable amount of grain, which otherwise would have been used for the brewing of beer, to be utilized for the manufacture of this sugar. Malt syrup is stated to have much resemblance to maple syrup, and to be an excellent substitute for cane sugar, though its use on the table may not be so convenient. For cooking and baking purposes, and for some forms of candy manufacture, it is considered in some respects to be superior. It is now being used largely in baking and "soft-drink" factories, its price being about 9 cents. per lb. It is characterized as "an excellent wholesome syrup of delicious flavour."

In regard to the supply of nitrogenous manures, it is of some interest to notice that steps are being taken by Messrs. Brunner Mond & Co., Ltd., and Explosives Trades, Ltd., to establish at Billingham-on-Tees, Durham, England, a factory for the production of ammonia synthetically from the air.[4] The extent of the operation is shown by the fact that a capital of about £5,000,000 will be required; and the process adopted is stated to be that generally known by the name of the German chemist, Haber. The demand for ammonium salts and nitrates in agriculture and other industries is sufficiently large to absorb the output of such a considerable installation as is projected, while in case of emergency it can be converted to war purposes. In connexion with the Haber process, which depends upon the combination of nitrogen and hydrogen at high temperature under pressure, it may be added that M. Georges Claude[5] claims that it is possible industrially to utilize pressures of 1000 atmospheres and over, under which conditions the combination into ammonia takes place with such intensity that a very small apparatus is capable of considerable output. Whereas originally Haber could get only 0·33 grms. of ammonia per catalytic grm., M. Claude claims that he can obtain 10 grms.

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[1] *I.S.J.*, 1919, 226. [2] *I.S.J.*, 1918, 561; 1919, 180; 1920, 55. [3] *I.S.J.*, 1919, 86, 250 and 284.
[4] *The Times*, April 22nd, 1920. [5] *Comptes rendus*, 1920.

Review of Current Technical Literature.[1]

Recovery of the Ammonia evolved during Clarification and Evaporation in the Beet Factory. (1) ***Franz Sterba.*** *Zeitschrift für Zuckerindustrie der Cecho-slovakischen Republik, 1919, 44, No. 2, 9-10.* (2) ***Ed. Donath.*** *Ibid., 1919, 44, No 9, 61-64.*

(1) That during the clarification, heating, and evaporation of beet juice, a certain amount of ammonia is evolved is evident by its smell in the factory. Some may have originally been present in the juice in combination as salts; but its formation is mainly due to the action of the lime on the amino-compounds, as asparagin and glutamin, the salts of the corresponding amino-acids being produced while the ammonia is evolved with the steam and carbon dioxide during liming and carbonatation. It also results from the gradual degredation of protein substances during the heating and boiling of the alkaline juice. Since sulphate of ammonia now costs K. 1·2 per kg.[2] in Czecho-slovakia, it is certainly of interest to consider whether it is not feasible to recover this valuable constituent, even though it may pass into the steam in comparatively small quantity.

(2) Regarding the amount that may be obtained from the juice, the figures stated by early workers are somewhat higher than those computed by investigators at the present day. Thus J. Reiset[3] obtained 0·634 grm. (as NH_3) on distilling one litre of expressed juice in the presence of alkali; and Leplay and Cuisinier,[4] 0·77 grm. On the other hand, Mr. Donath treated three lots of expressed beet juice (it being impossible at the time to obtain diffusion juice) with 2, 3, and 4 per cent. of lime (calculated on the weight of the roots), and slowly distilled the liquid, finding 0·214, 0·3145, and 0·322 grm. per litre respectively, or 0·1004, 0·1480, and 0·1519 grm. of NH_3 per kg. of roots. On the basis of these experiments, the amount of ammonia that might be obtained in a factory slicing 6000 quintals (nearly 600 tons) of roots per day is 98·58 kilos. (217 lbs.) of ammonia, or 382·7 kilos. (842 lbs.) of sulphate of ammonia; so that at the end of a campaign of 90 days the quantity of sulphate of ammonia from the clarification department would be nearly 34 tons, the recovery from the vapours of the effect not being considered.

Coming to the important question of effecting this recovery, it is suggested that the steam from the heaters and the carbonatation tanks might be drawn off by means of a fan, partially cooled to separate some of the water, passed over caustic lime to absorb a further quantity of the water, and the vapour (now rich in ammonia) sent through suitable towers or chambers for absorption by sulphuric or hydrochloric acid.[5] This part of the problem would be comparatively simple; but the matter of the treatment of the multiple effect vapours is rather more difficult. In 1889, Pöleke[6] took out a patent for a method of separating the ammonia from the vapour between the first and the second bodies of the evaporators, using sulphur dioxide, the ammonium sulphite condensing and gravitating, being later easily oxidized to the sulphate. Hudec[7] used potash alum solution, preferably in the form of a spray, obtaining thus a solution containing potassium sulphate and ammonium sulphate, and a precipitate of aluminium hydroxide. They claimed the recovery of 2·18 kilos. of ammonia from 100 quintals of roots, or 47·2 kilos. in 24 hours out of a total quantity of 56·1 kilos. present in the evaporator vapours. In recent years a process on the lines of Pöleke's patent has been protected by the A.-G. der Chemischen Produktenfabrik Pommernsdorf, of Stettin, Germany, and Robert Siegler, of the same place,[8] for the separation of ammonia from large volumes of gases or vapours; and attention is called to this process as one of probable practical interest. Sulphur dioxide is mixed with the steam from the carbonatation tanks or the multiple effect apparatus, and the ammonium sulphite separated by drawing it into the casing of a centrifugal fan, a warm atmosphere saturated with moisture being continually maintained. Some ammonium sulphite may remain, and if desired the gases may subsequently be sent through a wooden tower packed with coke or wood charcoal, in order to effect a practically complete separation.

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[1] This Review is copyright, and no part of it may be reproduced without permission.—(Editor, *I.S.J.*)

[2] Assuming 1 krone to have the pre-war value of 10d., the cost of one ton of sulphate of ammonia would be about £51.

[3] *Comptes rendus*, 1868, 190, 481.

[4] *Dingl. Polyt. J.*, 1868, 482.

[5] Vibran's German Patent, 15,513 of 1881, dealt with a similar method of absorbing the ammonia.

[6] German Patent, 52,885.

[7] German Patent, 84,838 of 1895; *Zeitsch. Zuckerind. Bohm.*, 19,339.

[8] German Patent, 281,095; accepted December 12th, 1914.

Deterioration of Raw Sugars by Mould Spores. *Nicholas Kopeloff, S. Byall, and Lillian Kopeloff. Journal of Industrial and Engineering Chemistry, 1920, 12, No. 3, 256-257.*

W. L. Owen [1] has pointed out that moulds constitute the most dangerous group of micro-organisms causing the deterioration of raw sugars, since they have a strong inverting power, and are able to exert it in highly concentrated solution. Experiments carried out by the authors of the present paper lead to the conclusion that "the factor of safety for sugars well infected with moulds would appear to be lower than is generally supposed." They present evidence of the deterioration of sugars having factors from 0·08 to 0·29; whereas experience hitherto has generally indicated that factors less than 0·333 may be regarded as safe. *Aspergillus* Sydowi Bainier and *A. niger* exhibit the greatest effect in hydrolysing sucrose, and are closely followed by *Penicillium expansum*. As in the case of other moulds, they are capable of exerting deteriorative activity in the spore as well as in the mycelial stage. Deterioration by moulds depends, not only upon the concentration of the film of molasses surrounding the crystals, but also upon the number of moulds present; and according to these authors, "there is evidence that an increase in inoculum is responsible for an increase in inversion at any definite concentration [2] . . . ."

Production of Alcohol from Mowra (Mohwa) Flowers. *Anon. Bulletin of the Imperial Institute, 1919, 17, No. 3, 401-406.*

Mowra flowers (the product of the Bassia tree, of which there are three species, *B. latifolia*, *B. longifolia*, and *B. butyracea*) are rich in sugars, containing 3 to 17 per cent. of sucrose and 40 to 53 per cent. of invert sugar. They are highly valued in India as a food-stuff, the *per capita* consumption in the Central Provinces being estimated at 80 lb. They are also used for the preparation of a sugar equal in quality to date sugar and for the production of a spirituous liquor; while the seeds of the Bassia tree yield an edible fat, known as Illipé butter, which before the war was used in Germany and Belgium for the manufacture of margarine, soap, candles, etc.[3] At the present time the greater portion of the crop of flowers is used for mowra spirit or *daru*, which has an offensive butyraceous odour and is rich in fusel oil.[4] By native methods, 1 maund ($82\frac{2}{7}$ lbs.) of dried flowers yield 2·12 gall. of proof spirit (2·88 gall. per cwt.); but in England it was found that over 6 gall. could be obtained per cwt. Formerly there was a considerable export of the flowers to Marseilles for use in making a cheap brandy; but about 1888 the French Government stopped the import, in order to protect the home grape industry.

During the war interest was centred in the production of acetone from Bassia flowers in India to supply the local demand in connexion with the manufacture of munitions, using a well known fermentation process by which the yield was nearly ten times that obtained by the ordinary method of wood distillation. It is pointed out in this article that it seems likely that the most profitable manner of utilizing the flowers would be as a source of an alcoholic motor spirit (of the "Natalite" type), and it is stated that about 90 gall. of 95 per cent. alcohol is obtainable from 1 ton of dried flowers.[5] Whether such a project would pay would depend largely on the cost of collecting the raw material, and on the quantity available. According to information supplied to the Inter-Departmental Committee on Alcohol Motor Fuel by the Director of Commerce and Industries to the

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[1] *I.S.J.*, 1919, 335.

[2] See also *Jl. Agric. Research*, 1919, 195-209; 1920, 537-542.

[3] *Bulletin of the Imperial Institute*, 1911, 9, 228; 1915, 13, 342; also Imperial Institute Monograph entitled "Oil Seeds and Feeding Cakes" (John Murray), London, 1915.

[4] See Elsworthy, *J. Soc. Chem. Ind.*, 1887, 6, 23.

[5] This appears to be an over-statement.

Nizam of Hyderabad, the total cost of collecting and drying the flowers and delivering them to a factory in the zone of growth amounts to 30s. per ton,[1] and it has been estimated that in the Hyderabad State there are already sufficient trees for the production of 700,000 gall. of proof spirit per annum,[2] in addition to that necessary for the local liquor requirement.

DENATURED ALCOHOL. (1) *P. de Sornay. Bulletin de la Société des Chimistes de Maurice, 1919, 10, No. 39, 32-33.* (2) *E. Haddon. Ibid., 1919, 10, No. 39, 34.*

(1) Owing to the scarcity of suitable denaturants (as wood naphtha) in Mauritius, it has been necessary for the Government in that colony to confine the sale of alcohol to certain firms only, but this restriction of distribution is causing considerable inconvenience to those requiring spirit for burning and other purposes other than consumption. In order to be able immediately to detect the addition of denatured alcohol to spirit intended for drinking purposes, it is proposed by Mr. de SORNAY to add to the more or less denatured product a certain amount of phenolphthalein. As every chemist well knows, this substance is colourless in an acid solution, but turns an intense crimson when the liquid is made alkaline, which coloration cannot easily be destroyed by the action of permanganate or animal charcoal. Ordinary denatured alcohol (which is slightly acid) might therefore be treated with, say, 25 grms. of the substance per hectolitre, and the cost would be only about 3 sous per litre; if this were done it would be capable of instant recognition either alone or in admixture with other spirits by the Inspector on the addition of a drop or two of a solution of alkali. (2) Mr. HADDON pointed out that he and his late friend M. BONNIN had previously proposed the use of phenolphthalein for the recognition of untaxed alcohol, but for certain reasons the Government had not taken advantage of the suggestion. He cited a reference[3] showing that others had called attention to the advantages possessed by phenolphthalein. "In fact, without changing its character, one may easily dissolve 1 grm. of this substance in one hectolitre of spirit; owing to the acidity of the medium the coloration does not change, though this amount is nevertheless sufficient to be recognized with certainty by the addition of a little caustic soda liquor, . . . while at the dilution indicated its ingestion has no harmful effect."

MUD FILTRATION IN THE CANE FACTORY. *William Searby. Report of Committee on Manufacturing Machinery, Hawaiian Sugar Planters' Association, 1919.*

An apparatus which supplies mud to the filter-presses at a constant pressure is the ideal arrangement. Probably the main difficulty in filtering at the present time is the pulsating delivery of the reciprocating pumps, the shock disturbing the layer, and compacting it, so that passage through it becomes no longer easy. There is also the possibility of this shock freeing the slime which has covered the fine particles of bagasse, allowing it to clog the cloths. Formerly the *monte-jus* with steam or compressed air was used to a great extent; but as its operation is intermittent and requires two apparatus for interrupted flow, and as the steam dilutes the juice and caramelizes the sugar, this type of lift has gradually been superseded by others. Centrifugal pumps give a steady pressure, but on account of the abrasive nature of the material they require constant repair. Gravity is often resorted to, the mud being pumped to a tank from which a sufficient pressure may be realized. Some claim that good results may be obtained with a head of 20 ft. or so throughout the whole operation; others assert that 20 lbs. is sufficient to fill the press, but that the filtration must be finished at 40 lbs. pressure to the sq. in.; while others again state that 40 lbs. throughout the whole operation is necessary. It seems that the method of commencing the process at a low and steady pressure to allow the cake to form completely without compacting too much, and finishing up at a high pressure, is most advantageous. Supporting the cloth on perforated plates or on a wire screen is not necessary with the mud handled and at the pressures used at the present time in Hawaii, though before the advent of the shredder and the grooved roller the cloths were soon clogged up, making it necessary to use higher pressures with the result that the cloth was forced firmly between the ribbed supports. Now, however, the slimes are taken up to such an extent in the cake itself that only a small percentage reaches the cloth.

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[1] At the present time, in most districts in India at any rate, collection would cost very considerably more than this figure.—ED. *I.S.J.*

[2] See G. M. RYAN, *Indian Forester*, 1918, 44, 302.

[3] *Bulletin de l'Association des Chimistes de France*, 1900-01, 605.

CALCULATION OF THE "COMMERCIAL CANE SUGAR" IN CANE. *W. E. Appleby. Chemical, Engineering and Mining Review (Melbourne), 1919, 12, (October 5th). 33-38.*

In the calculation of the "commercial cane sugar" in the cane as prescribed by the Queensland Government for general use in that country, three determinations are involved, namely: (1) cane sugar (sucrose) in the juice by the polariscope; (2) total soluble solids by the Brix hydrometer; and (3) fibre or insoluble matter of the cane, by diffusion. According to a proclamation recently made the commercial cane sugar is calculated from the following values:—

$$\text{Total soluble solids in juice} \times \frac{100 - (3 + \text{fibre})}{100} = \text{total soluble solids in the cane.}$$

$$\text{Sucrose in the juice} \times \frac{100 - (5 + \text{fibre})}{100} = \text{sucrose in the cane.}$$

Total soluble solids in the cane — sucrose in the cane = impurities in the cane.

$$\text{Sucrose in the cane} - \frac{\text{impurities}}{2} = \text{commercial cane sugar in the cane.}$$

Considerable time is demanded in such calculations, and if 20 or 30 samples per diem are analysed the figuring will be voluminous. Mr. APPLEBY therefore has compiled nomon or autocalculus graphs for facilitating the computation of these results, and the method he describes for doing this will be given later.

CARBOHYDRATES OF FRESH AND DRIED VEGETABLES (CARROTS, POTATOES, CABBAGES AND TURNIPS). *R. George Falk. Journal of Industrial and Engineering Chemistry. 1919, 11, No. 12, 1133.*

Vegetables were examined in regard to their content in sugars, before and after desiccating by the air-blast and vacuum processes, the following being some of the results (calculated on 100 parts of dry matter) obtained in the cases of carrots [1] and potatoes:—

	Carrots.		Potatoes.	
	Fresh.	Dried.	Fresh.	Dried.
Reducing sugars	57·1	53·8	2·5	2·9
Hydrolysable sugars	35·1	31·9	2·4	2·3
Dextrin and soluble starch	2·7	3·7	0·5	0·5
Starch (by difference)	5·1	10·6	94·6	94·3

NEW BAUMÉ SCALE FOR USE IN SUGAR WORK. *Fred. J. Bates. Facts about Sugar, 1919, 9, No. 24, 470-471.*

It would certainly be more advantageous if the sugar industry generally were to adopt the Brix hydrometer scale; but as the Baumé system is much employed, the question of the most accurate system of graduation must be considered. Hence the Bureau has re-calculated the scale on the specific gravity determinations of Plato (regarded as the most scientifically correct), and has adopted the modulus 145 and the temperature of 20/20 C. This scale[2] has now been adopted by the Association of Official Agricultural Chemists as the official Baumé scale, and all other tables not in accordance with it are to be eliminated from their publications.

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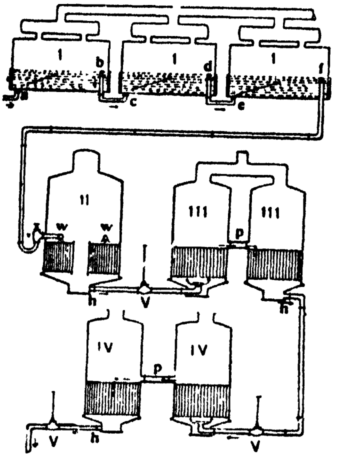
[1] See also *J.* BUSOLT, *Jl. Landw.*, 1916, 64, 357-360, 361-362, who points out that the sugars in carrots are mannitol and dextrose.

[2] *I.S.J.*, 1918, 573.

Review of Current Technical Literature.

ARRANGEMENT OF THE UNITS OF THE MULTIPLE EFFECT EVAPORATOR FOR INCREASING THE REGULARITY AND RATE OF CONCENTRATION. *Franz Paulik.* *Zeitschrift fur Zuckerindustrie der Cechoslovakischen Republik, 1919, 44, No. 9, 64-66.*

In enlarging the evaporation station, it may not infrequently happen that the plant is so arranged that body I consists of 2 or 3 units, and also that bodies II and III of the multiple effect are composed of 1 or 2 individual members, the juice inlet and outlet to each being usually separate. It often results that from one body more juice is drawn than from the others, causing the density to vary in the units of the same body, an irregularity that unfavourably influences the course of evaporation. In the author's factory at Unter-Cetno, Czecho-Slovakia, there is a quadruple consisting of 3 first, 1 second, 2 third, and 4 fourth bodies. As the sketch shows, the juice enters body I at *a*, travelling across to the outlet *b*, from *c* to *d*, and from *e* to *f*. It passes along the connecting line through a regulating valve into body II; but in order to distribute the juice it enters through a ring *w*, having a series of perforations. After leaving this unit, passes though a valve *v* to body III through an elbow, above which is fixed a round plate serving to divide the juice and send it up all the heating tubes. A valve *v* controls the amount passing into body IV, and here another circular plate regulates its delivery up the tubes. Thence it goes through over-flow pipes *p* into the second unit of the body, its discharge being regulated by the valve *v*. By such an arrangement, and by maintaining a low juice level, boiling can be carried on vigorously and regularly. Syrup leaving the last unit has a density of 35-36°Bé. (64-66° Brix). It is pumped through a heater having a surface of 11 sq. m. (118 sq. ft.) to raise it to 80-85° C., and discharged into the pan supply tanks. It may be added that a very valuable device for observing the density is to be found in Ryska's apparatus,[1] which is attached to the piping of the thick-juice pump. It enables hydrometer readings of the syrup passing through the line to be made at any moment both rapidly and conveniently.



DETERMINATION OF SUCROSE BY THE DOUBLE POLARIZATION METHOD, USING MONOCHLORACETIC ACID AS HYDROLYST. *George W. Rolfe and L. F. Hoyt.* *Journal of Industrial and Engineering Chemistry, 1920, 12, No. 3, 250-253.*

An objection that is urged against the ordinary double polarization method, as elaborated by HERZFELD, is that the direct reading is taken on a slightly alkaline solution, and the inversion reading on a strongly acid one, the result of this altered condition being that the difference between the two readings is not due only to the hydrolysis of sucrose but also to the change in the rotation of certain other optically-active constituents (invert sugar, in the case of cane products). A good deal of work has been done on the elimination of this source of error. ANDRLIK,[1] for example, has proposed that the direct reading should be made in the presence of the same amount of hydrochloric acid as that used for inversion, adding urea to retard the hydrolysis of the solution while observing; but this method has been shown by CROSS and others to be inapplicable when the laboratory temperature is high, as in tropical countries. It is now proposed to use monochloracetic acid as the hydrolyst, it having been found that at ordinary temperatures its hydrolysing power is very slight, while on heating in a boiling water-bath (under pressure) it is capable of effecting the inversion of the sucrose present. As is the usual practice, the normal weight of the sample is dissolved in water in a 100 c.c. flask clarified with lead acetate, made up to volume, and filtered. In effecting the direct reading, however, 50 c.c. of the filtrate are transferred to a 100 c.c. flask, 15 c.c. of a 20 per cent. solution of monochloracetic acid added, the volume completed to 100 c.c. with water, and the liquid polarized within 15 minutes. In making the invert reading, about 50 c.c. of the solution containing the monochloracetic acid are placed in a 50 c.c. flask, which is closed tightly with a rubber stopper, and immersed in a boiling water-bath for 30 minutes. At the end of this time, the liquid is cooled rapidly to room temperature, allowed to stand for at least two hours, and polarized in a 200 mm. tube in the usual way, the factor 141·00 being used for the calculation of the sucrose content. This new method was shown to give results agreeing very closely with the double polarization process using invertase, though it gave figures appreciably lower than those found by means of the ordinary Herzfeld procedure. Its chief disadvantage appears to be the rather considerable time required; but this is less than in the invertase method, or in those modifications of Herzfeld's process in which inversion is carried out at room temperature.[2] Another point is that if much lead acetate is used in clarification, and if the product contains much soluble salt, the hydrolysis is retarded somewhat, and it may be necessary to continue heating for about 60 minutes. Trichloracetic acid was tried; but found unsuitable, owing to the fact that the quantity necessary for hydrolysis at boiling point inverted the solution too rapidly in the cold. Moreover, it decomposed during the heating, giving off so much chloroform vapour as to burst the 50 c.c. flasks.

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[1] *Zeitsch. Zuckerind. Bohm.*, 1908-9, **33**, 378-379.

REPORT OF THE NEW YORK SUGAR TRADE LABORATORY DURING 1919.[3] *Dr. C. A. Browne. New York Sugar Trade Laboratory, Inc., 79, Wall Street, New York.*

Dr. BROWNE reports that a slight improvement was noted in the quality of the raw sugars tested during 1919, although the character of the product received in the latter part of the year was very inferior owing to its deterioration during storage. The average of the polarizations made in the years 1916, 1917, 1918, and 1919 were 95·3, 95·7, 95·4, and 95·6°. The loss from deterioration in 1919 was probably the greatest in the history of the sugar industry. That occurring during storage in Cuba alone, according to comparative analyses made at the laboratory, is estimated at over $5,000,000, and when the deterioration in transit and in storage after delivery are taken into account, the total loss from this source in 1919 probably approximates 1 per cent. of the value of the Cuban crop. The question has been asked whether the laboratory is now employing the new value of the U.S. Bureau of Standards for the 100° point of the polariscope scale. According to paragraph 14 of the Rules and Regulations of the Sugar Trade Laboratory, the methods of polarizing sugars shall in all cases be those of the International Commission for Uniform Methods of Sugar Analysis, and until this Commission adopts the new value, no changes shall be made in the methods or standards employed by the Laboratory.

OCCURRENCE OF MELICITOSE IN MANNA AND HONEY. *C. S. Hudson and S. F. Sherwood. Journal of the American Chemical Society, 1920, 42, 116.*

Melicitose, or melezitose, $C_{18}H_{32}O_{16}\ 2H_2O$, has been known for some time to occur in the manna of different trees.[1] This trisaccharide has now been found to be present in samples of comb honey from Port Royal, Pennsylvania, and from Maryland. An investigation by Dr. EDGAR T. WHERRY[4] discloses the fact that the bees collect a sweet fluid deposited on the twigs of the Virginia pine by a soft scale insect, or at other times by an aphid, this fluid, which contains much melicitose, being stored away by them in place of floral nectar. Analytical data relating to this type of honey are recorded, and a method for the approximate determination of the carbohydrate under discussion is described. It is questioned whether melicitose may not be present in the sap of most coniferous trees.

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[1] *Zeitsch. Zuckerind. Bohm.*, 1906, 417; *I.S.J.*, 1911, 149. [2] *I.S.J.*, 1913, 489.

[3] For previous reports, see *I.S.J.*, 1915, 187; 1916, 286; 1917, 141; and 1918, 334.

[4] See also HUDSON and SHERWOOD. *J. Amer. Chem. Soc.*, 1918, 40, 1456. [5] *Ibid.*, 1920, 42, 125.

Review of Current Technical Literature.

Solubility of Lactose and its Behaviour towards Acids and Alkalis. *E. Saillard.*

Chimie et Industrie, 1919, 2, 1035-1036.

The solubility of lactose (anhydrous) at various temperatures (in kilos. of sugar per 1 kilo of water) was found to be as follows, that of sucrose under the same conditions being given for comparison :—

Temperature, °C.	Lactose.	Sucrose.
21·5	0·20	2·06
28·0	0·24	2·16
38·0	0.307	2·34
48·0	0·421	2·55
57·0	0·56	2·78
65·0	0·77	3·03

Lactose is completely hydrolysed in 90 minutes when heated at 90° C. with 10 per cent. hydrochloric acid, but is not appreciably attacked by 10 per cent. acetic acid. When it is heated at 90° C. with 1 per cent. sodium hydroxide solution, about 64 per cent. of the alkali is neutralized and 85 per cent. of the sugar is destroyed within 2 hours.

Determination of Formaldehyde in Formalin Solutions. *R. H. Robinson.*

Chemist-Analyst, 1920, 29, April, *21-22.*

According to the method prescribed by the Association of Official Agricultural Chemists[1] for the determination of formaldehyde in its solutions (as formalin), oxidation is effected by heating with hydrogen peroxide on the steam-bath for 5 minutes, the formic acid formed being titrated with standard alkali, using litmus as indicator. This procedure has been found by the author to give inexact results, owing either to loss of formaldehyde while heating, or to incomplete oxidation in the time stated ; but the following process is stated to be quite reliable : 25 c.c. of N/1 sodium hydroxide and 50 c.c. of hydrogen peroxide are placed in a 200 c.c. Erlenmeyer flask ; and 1·5 to 2·0 grms. of the formaldehyde solution under examination added by means of a pipette, allowing its point to nearly reach the liquid in the flask. This mixture is set aside for several hours, preferably overnight. Lastly, the excess of sodium hydroxide is titrated with N/1 acid (1 c.c. = 30 02 mgrms. of $HCHO$), using purified litmus solution as indicator. It is important that sufficient hydrogen peroxide be present ; and this reagent should of course previously be neutralized, if necessary.

Manufacture of Plantation White Sugar in Natal using the Carbonatation Process. *Anon.* *South African Sugar Journal, 1920, 4, No. 3, 217-221.*

At the factory belonging to Natal Estates, Ltd., in South Africa, about 16,200 tons of plantation white sugar were made last season under the supervision of Mr. Robert Campbell by the carbonatation process, operating upon Uba cane juice, the refractory nature of which is well known. Even with a partially complete equipment, satisfactory results were obtained, and it is claimed that a beautiful sugar very often equal to refined was produced ; that the recovery was increased by 6 per cent., compared with that realized by the defecation process ; and that the work of the factory was easier than formerly, especially at the filter-press station, while the time required for boiling and curing was notably less than before. It is also stated that the average increase in purity from raw juice to syrup was 3·05°, whereas under the defecation method it was only 0·38°, or at best 0·51°. Concluding, the anonymous author asserts that "there seems no doubt that the carbonatation process will be ultimately adopted in Natal for the treatment of the Uba juices for cargo as well as for white sugars." No particulars of cost are given, though it mentioned that "as limestone can be procured in large quantities and of excellent quality in this country (while sulphur has to be imported) the employment of the larger quantity of lime (about 10 times that required in sulphitation) is possibly no disadvantage."

J. P. O.

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[1] *Journal of the Association of Official Agricultural Chemists*, 1916, 2, No. 1, 17.

Review of Recent Patents.[1]

UNITED KINGDOM.

Apparatus for the Prevention of Entrainment in Evaporators. ***Nicolas A. Helmer***, of New York. *125,939* (*5044*). Date of application, February 28th, 1919; convention date, April 25th, 1918; complete accepted, November 13th, 1919. (Seven figures.) See also U.S. Patent, *1,304,681*[2].

FIG. 3.

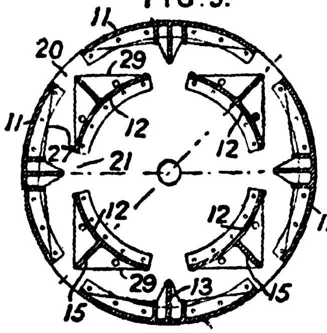
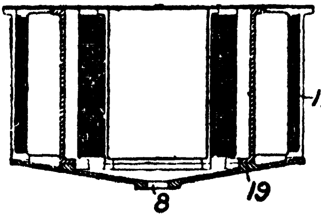


FIG. 4.



The apparatus described depends upon the principle that when vapour containing fluid particles impacts against and travels along a foraminated wall (not through it), the liquid is retained in the form of small drops by being caught in the meshes of the woven fabric. As the process continues, the capillary attraction which the retained drops have for other minute particles of the same fluid touching them causes the collection of additional fluid upon the foraminated walls. The construction is such that a relatively narrow path for the vapours is provided, in order to expose the greatest possible area of woven fabric. Referring to the drawings, vapour enters a casing *11* fitted at the top of an evaporator through vertical openings *20* and passes between sheets *27*, *29* of the foraminated material to openings *21* in an inner casing *12* arranged directly below the vapour outlet pipe. The sheets are passed over ribs *13*, *15* formed on the casings and arranged to project towards the openings *21*, *20*. The liquid collecting on the sheets falls on the inclined bottom *19* and returns to the evaporator through an opening *8*.

Manufacture of Glycerin from Sugar Products (Molasses, etc.) ***Vereinigte Chemische Werke Akt.-Ges.***, of Berlin, Germany. *138,099* (*1841*). Date of application, January 20th, 1920; *not yet accepted.*

Glycerin is obtained by the fermentation of sugar in alkaline solution in the presence or absence of a suitable catalyst. Suitable alkaline substances are ammonium phosphate, ammonium carbonate, sodium phosphate, carbonate, or bicarbonate, an amine, a salt of an amine, or mixtures of these; whilst suitable sugar products are grape sugar, invert sugar, saccharified starch, maltose, and purified molasses or syrup. Commercial yeast, yeast cultures, or other species of yeast may be used for fermenting, and food for the yeast may be added to the liquid. Suitable catalysts are manganese sulphate and iron sulphate. For example, 200 grms. of sugar and 140 grm. of disodium hydrogen phosphate are dissolved in two litres of water and fermented by the addition of 50 grms. of commercial yeast at 30° C.; the liquid being afterwards decolorized by boiling with animal charcoal, filtered, evaporated, and the glycerin extracted by alcohol, which is then distilled off. The yield is stated to be 12 per cent. of the sugar originally present before concentration. The fermented liquid may be purified by lime, magnesia, or iron compounds.[3]

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[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States:* Commissioner of Patents, Washington, D C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 2 fr. 00 each).

[2] *I.S.J.*, 1919, 627. [3] *I.S.J.*, 1919, 243, 340, 412, and 471.

CONFECTIONERY MACHINERY. *National Equipment Co.*, of Springfield, Mass., U.S.A. *136,793 (22,678)*, Date of application, September 15th, 1919; complete accepted.

In coating machines of the type in which chocolate is discharged upon the confections through a slot, the slot is kept clear from obstructions by scrapers traversing it during the the flow.

COCOA PREPARATION MADE WITH BEET JUICE. *Paul Kestner*, of Paris. *136,205 (14,970)*. Date of application, September 14th, 1918; complete accepted.

Cocoa is mixed with beet juice, and concentrated and freed from disagreeable taste and odour by the process recently described.[1] Vanilla, cinnamon, cloves, or other flavouring matter, may be added, and part of the cocoa fat may be removed.

STARCH PREPARATION. *Lewis W. Goold and American Laundry Machinery Co.* of Cincinnati, Ohio, U.S.A. *135,588–135,594*. Date of application, November 27th, 1918; complete accepted, November 27th, 1919.

UTILIZATION OF STARCH RESIDUES FOR THE PREPARATION OF GLUCOSE. *Jean Effront and Auguste Boidin*. *122,405* (*131*). Date of application, January 2nd, 1919; complete accepted, December 4th, 1919.

In the present state of the starch industry, considerable quantities of refuse are produced, which, in view of the small commercial value they possess, can only be utilized as animal fodder. They are therefore subjected to the action of liquefying diastases of the kind previously described by the inventors[2] using a temperature of 70°–85°C. for a period of half to one hour in a slightly alkaline water, the starch being thus saccharified. After filtering and evaporating the liquid, a crystallizable syrup is obtained.

MANUFACTURE OF LACTOSE. *Geoffrey Martin*, of the Co-operative Wholesale Society, Ltd., of Manchester. (1) *135,614* (*19,692 ; 21,833*). Date of application November 28th, 1918, December 30th, 1918; complete accepted, November 28th, 1919. (2) *135,969* (*20,836*). Date of application, December 13th, 1918; complete accepted, December 11th, 1919.

In order to precipitate the proteins from the whey obtained in cheese-making, either metaphosphoric acid, orthophosphoric acid, a mixture of phosphate and acid (e g., sodium phosphate and acetic or hydrochloric acid), tannic acid, alum, mercurous nitrate, phosphotungstic acid, or magnesium sulphate may be added. Finally, the liquor is concentrated and the lactose allowed to crystallize out.

SLAKING CAUSTIC LIME. *Spoerri & Co.*, of Zurich, Switzerland. *135,172* (*26,354*) Date of application, October 27th, 1919; *not yet accepted.*

An apparatus is described for slaking large quantities of caustic lime by spraying with water in a rotary sieve contained in a drum.

EVAPORATION OF FRUIT JUICES FOR USE IN JAM AND PRESERVE MANUFACTURE. *Barbet et Fils et Cie.*, of Paris, France. *135,175* (*27,401*). Date of application, November 6th, 1919; *not yet accepted.*

A multiple effect apparatus is described which is particularly applicable to the concentration of grape, apple, and other fruit juices that have been treated with sulphurous acid. Thus, white grape juice is concentrated in one effect at, say, 75°C. to a syrup or honey for making jam, brandy or liqueur wines, or for any other purpose where an alteration in the flavour is unobjectionable; while the juice of black grapes for making red wines is concentrated in the other effect at 55°C., or lower, in order to prevent the coagulation of albumens or other changes of composition.

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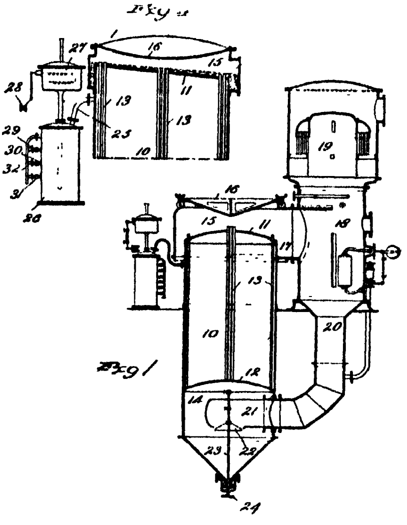
[1] *I.S.J.*, 1920, 115. [2] *I.S.J.*, 1919, 255.

UNITED STATES.

EVAPORATOR. ***Emile Augustin Barbet,*** of Paris, France. *1,325,461.* Date filed, June 28th, 1915; patented, December 16th, 1919. (Six figures.)

When the liquid to be evaporated is made to circulate through groups of closely assembled tubes, both liquor and vapour rise together, and their joint progress may take one or other of the following two modes of action :—(1) The movement in the tubes of those portions of the liquid which remain unevaporated is too slow in proportion to the rate of formation of vapour in these tubes, the masses of rising vapour forming progressively larger bubbles until finally the upper ends of the tubes are occupied by a central current of vapour, while the interior of the walls is covered by a creeping or climbing film of liquid. This condition is not at all favourable to the rapid transmission of heat, since it means a slow movement of the liquid. (2) The rate of vapour formation is properly related to the volume of liquid passing through, and the bubbles as they merge towards the upper ends of the tubes form a series of constantly rising individual masses, occupying substantially the entire cross-section of each tube and divided by horizontal masses of liquid which are pushed upwards by the vapour like a series of pistons. It is one of the principal objects of this invention to provide apparatus in which the conditions of flow may easily be controlled, thus enabling one to secure the maximum circulation and the maximum transmission of heat.

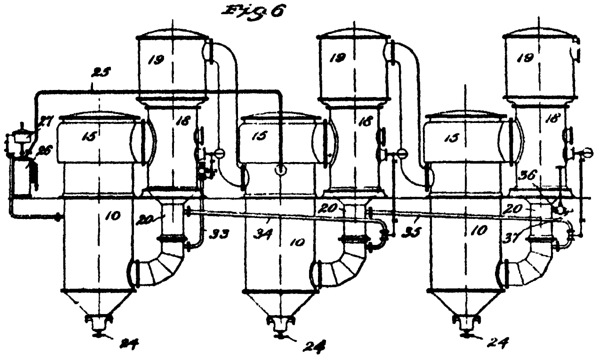


In figure *1*, the heating drum to which the steam is supplied is shown at *10*, the same having top and bottom plates at *11* and *12* respectively. Some of the vertical heating tubes are shown at *13*, these passing in a compact group through the heating chamber so as to lead the liquid upward from the lower chamber *14* to the overflow chamber *15*, which is closed by a cover *16*. As liquid and vapour rise into chamber *15* they pass together through a wide lateral passage into the wide return tube *18*. From this the vapour rises toward the exit *19*; while the liquid returns by the wide tube *20* to the lower chamber *14*, being joined on its way by a suitable volume of fresh liquid. It has been found by the inventor that the proper formation of vapour and liquid in the rising tubes *13* can be produced by suitably controlling the access of the liquid to this lower chamber *14*. For this purpose, the tube *20* is caused to terminate in a horizontal portion *21*, opening downward into the lower chamber *14*, this being done by a valve. This valve takes the form of a conical plate *22* upon a stem *23*, by means of which, and a hand-wheel *24*, the opening may be made larger or smaller at will. In this way, the pressure at the base of the tubes *13* may be regulated, and the desired speed of the ascending liquid may be secured.

To ensure non-reversibility of circulation, the top of the heating drum *10* is carried above the bottom of the upper chamber *15*, thus forming a circular channel around the drum *10*. Further, the top of the drum *10* is sloped, either in a plane inclined towards the exit passage (as seen in figure 4), or in a dome shape (as in figure 1). It is also preferable to extend the ends of the pipes *13* above the top of the drum *10*.

Preferably, moreover, means are provided for the automatic regulation of the pressure of live steam supplied to the drum *10*, particularly when the bodies are combined in a triple or quadruple effect. These means are shown in figure 4. At *28* is the admission valve, controlled by a float in the closed chamber *27*, which is placed over another closed chamber *26*, with which it communicates by a vertical tube (shown in dotted outline), reaching nearly to the bottom. There is a body of water within *26*, more or less of which is forced up into *27* by the pressure of the live steam in the drum *10*, exerted through the tube *25* upon the body of the water. When the pressure in the drum *10* drops, the water rises in the lower chamber, the float moves downward in the upper chamber, and the valve *28* is operated to increase the supply of live steam. When, on the contrary, the pressure rises in the drum *10*, the water rising under the float in *27* causes it to partly close the valve *28* to diminish the steam pressure. The three valves *29*, *30* and *31*, communicating with the overflow *32*, make possible the variation of the effective level of the water in vessels *26* and *27*. In a multiple effect battery, a single regulator suffices in connexion with one of the series (preferably the second or third), selecting one in which the boiling-point is 102 to 104°C.

Fig 6



Lastly, the mode of connecting up bodies in a triple is shown in figure 6. The juice enters the first through the pipe *33*; passes to the second by the pipe *34*; to the third by the pipe *35*; and is finally discharged through the valve *36* in the pipe *37*. In this arrangement the regulator *26* receives the pressure from the second cell of the series through the pipe *25*. It is thus possible to regulate the amount of liquid delivered to the first cell automatically by simply controlling the flow at the exit pipe by means of the valve *36*.

REVIVIFICATION OF VEGETABLE DECOLORIZING CARBON. *Andrew Adams and Samuel S. Peck.* *1,326,159.* Date of application, July 16th, 1917; patented, December 30th, 1919.

Spent decolorizing carbon is revivified by allowing it to ferment, after which it is heated with a solution containing an electrolyte, and washed. It is first placed in a wooden vat or tank; water is added until its level is about 2 in. above the mass; and fermentation is permitted to proceed spontaneously, or may be induced by inoculating with a suitable quantity of the micro-organisms taken from a previously treated batch. Generally the time required is 4 to 6 days, but the period depends to some extent upon the nature and amount of the impurities to be eliminated. Following fermentation, the mixture is transferred to an acid-resisting vessel, and diluted with three times its volume of water. After adding sulphuric acid to the amount say of 5 per cent. of 60° Bé. concentration of the carbon present, it is boiled for one hour. Enough sodium chloride may then be added to react with all the free acid present to form free hydrochloric acid and sodium sulphate, boiling being continued for another hour. Finally, the carbon is filtered, and well washed with warm water. Other electrolytes may be used for the elimination of the unfermentable colloidal impurities.

DEVICE FOR THE CLOSING OF FILTER-PRESSES. *James Miller and George Fletcher & Co., Ltd.*, of Derby. *1,331,351.* Date of application, June 3rd, 1919; patented, February 17th, 1920. See also U.K. Patent, *126,265*.[1]

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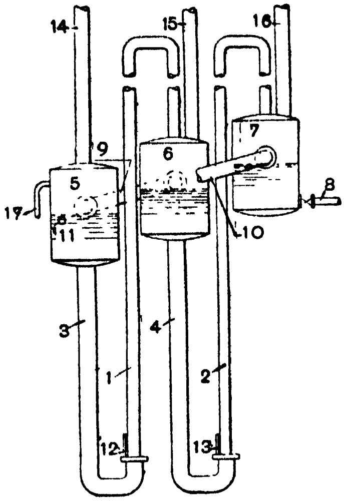
[1] *I.S.J.*, 1919, 413.

HOLLAND.

CARBONATATION OF SUGAR JUICES. *Cornelius Asselbergs*, of Breda, Holland. *3938*; class 89c; group 15. Date of application, October 15th, 1919; accepted, July 2nd, 1919. (Two figures).



A modification of the usual method of carbonatation consists of passing the gas under pressure into the liquid contained in a long tube, any excess of gas being trapped by untreated juice in an upper vessel. Neither this system,[1] nor a similar one which was recently protected,[2] however, is suitable (this specification states) in the case of juices of high lime content; while in the second process the formation of froth is a serious disadvantage. Satisfactory results are claimed by means of the inventor's apparatus shown in the figure, consisting of U-tubes into which the carbon dioxide is admitted at *12* and *13*. Untreated juice enters the vessel *5* attached to the arm *3*; is gassed at *12*; forced up into vessel *6*; and is again submitted to the action of carbon dioxide this time at *13*, lastly passing into *7* and out through *8*. Juice from the vessels *6* and *7* is returned into vessel *5* through the pipes *9* and *10*. Excess of gas escapes through *14*, *15*, and *16*; while *17* is a control tube. Tubes *1* and *2* are 25 cms. in diameter, and 12 to 15 metres high. About 3000 litres per minute of juice goes through tube *1*, and about 2000 through *2*; so that about 1000 litres of partly carbonatated liquor return along *9* to vessel *5*.

UNITED KINGDOM COMPLETE SPECIFICATIONS ACCEPTED.[3]

FILTER PRESSES. *P. W. Norman and Aluminium Plant and Vessel Co.* *140,715* (*26,358*). October 27th, 1919.

FILTER PRESSES. *Worthington Pump and Machinery Corporation.* *140,798* (*8798*). March 9th, 1918.

LIQUID FUELS. *U.S. Industrial Alcohol Co.* *140,796-140,797* (*8796-8797*). October 12th, 1917.

ADHESIVE MANUFACTURE. *M. O'Gorman and S. B. Schryver.* *140,911* (*9874*). April 17th, 1919.

SUPERPHOSPHATE MANURE MANUFACTURE. *H. Jones and E. Newall & Co.* *140,915* (*11,019*). May 3rd, 1919.

CONTINUOUS VACUUM FILTER *A. E. Alexander and United Filters Corporation.* *141,001* (*2581*). December 30th, 1918.

CANE MILLS. *J. Miller and Geo. Fletcher & Co., Ltd.* *141,078* (*11,167*), August 8th, 1916.

DELIVERING TABLETS, LOZENGES, ETC., IN CONFECTIONERY MANUFACTURE. *F. B. Behr.* *141,474* (*5809*). September 26th, 1919.

AGEING SPIRITS AND ALCOHOLIC LIQUORS. *A. Jarraud.* *141,687* (*9321*). April 17th, 1919.

PROCESS AND APPARATUS FOR THE MANUFACTURE OF COCOA AND CHOCOLATE. *F. E. Whitham.* *141,953* (*13,819*). May 31st, 1919.

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[1] French Patent, 346,856 (of 1905).

[2] German Patent, 289,644.

[3] The date given is that of application.

Sugar Crops of the World.

(Willett & Gray's Estimates of Crops to April 15th, 1920.)

	Harvesting Period.	1919-20. Tons.	1918-19. Tons.	1917-18. Tons.
United States—Louisiana	Oct.-Jan.	103,202	250,802	217,499
Texas	,, ,,	..	..	..
Porto Rico	Jan.-June	426,631	362,618	413,958
Hawaiian Islands	Nov.-July	500,000	538,913	515,035
West Indies—Virgin Islands	Jan.-June	12,000	9,000	5,400
Cuba	Dec.-June	4,000,000	3,971,776	3,446,083
British West Indies—Trinidad	Jan -June	65,000	47,850	45,256
Barbados	,, ,,	70,000	80,000	65,230
Jamaica	,, ,,	50,000	40,000	34,300
Antigua	Feb.-July	12,000	10,000	9,409
St. Kitts	Feb.-Aug.	11,000	9,300	8,846
Other British West Indies	Jan.-June	10,000	10,000	16,745
French West Indies—Martinique	Jan.-July	22,000	20,712	20,881
Guadeloupe	,, ,,	31,000	26,604	30,382
San Domingo	Jan.-June	180,000	158,309	127,322
Haiti	Dec.-June	5,000	3,300	....
Mexico	,, ,,	85,000	60,000	40,000
Central America—Guatemala	Jan.-June	15,000	13,441	22,809
Other Central America	,, ,,	20,000	15,000	10,000
South America—				
Demerara	Oct.-Dec. and May-June	90,000	107,560	108,181
Surinam	Oct.-Jan.	12,000	8,000	9,739
Venezuela, *exports*	Oct.-Dec.	18,000	15,000	15,000
Ecuador	Oct.-Feb.	7,000	7,000	8,000
Peru	,, ,,	250,000	250,000	265,000
Argentina	May-Nov.	260,000	130,266	87,699
Brazil	Oct.-Feb.	187,000	183,079	148,958
Total in America		6,441,833	6,328,530	5,671,732
Asia—Brit. India (consumed locally)	Dec.-May	3,001,000	2,370,000	3,311,000
Java (1920-21, 1,526,500)	May-Nov.	1,335,763	1,749,408	1,778,345
Formosa and Japan	Nov -June	300,000	415,678	397,618
Philippine Islands	,, ,,	225,000	195,289	216,260
Total in Asia		4,861,763	4,730,375	5,703,223
Australia	June-Nov.	175,000	226,000	325,900
Fiji Islands	,, ,,	60,000	80,000	70,800
Total in Australia and Polynesia		235,000	306,000	396,700
Africa—Egypt (consumed locally)	Jan.-June	90,000	82,000	79,450
Mauritius	Aug -Jan.	235,000	278,555	249,000
Réunion	,, ,,	40,000	50,000	50,000
Natal	May-Oct.	150,000	144,000	106,250
Mozambique	,, ,,	50,000	50,000	50,000
Total in Africa		565,000	604,555	534,700
Europe—Spain	Dec.-June	3,000	6,618	7,039
Total cane sugar crops		12,106,596	11,976,078	12,313,394
Europe—Beet sugar crops		2,809,000	3,697,499	4,291,206
United States—Beet sugar crop	July-Jan.	650,000	674,892	682,867
Canada—Beet sugar crop	Oct.-Dec.	16,500	22,300	11,250
Grand total Cane and Beet Sugar	**Tons.**	**15,582,096**	**16,370,769**	**17,298,717**
Estimated decrease in the world's production	**,,**	**788,673**	....	....

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

	One Month ending April 30th.		Four Months ending April 30th.	
	1919. Tons.	1920. Tons.	1919. Tons.	1920. Tons.
UNREFINED SUGARS.				
Russia	....	....	....	..
Germany	....	4,029	....	4,830
Netherlands	....	....	1	....
Belgium	....	....	....	....
France	....	....	....	....
Austria-Hungary	....	....	. ..	....
Java	28,689	....	72,108	162
Philippine Islands	....	....	....	....
Cuba	64,603	118,687	164,693	242,368
Dutch Guiana	....	....	961	....
Hayti and San Domingo	...	....	....	....
Mexico	....	....	....	....
Peru	3,276	1,863	18,590	18,192
Brazil	329	646	329	5,779
Mauritius	36,117	16,082	83,634	95,407
British India	....	1,540	....	3,026
Straits Settlements	....	....	....	....
British West Indies, British Guiana & British Honduras	12,523	22,140	15,629	37,188
Other Countries	1,032	402	1,325	12,554
Total Raw Sugars	**146,569**	**165,389**	**357,270**	**419,505**
REFINED SUGARS.				
Russia	....	....	....	....
Germany	....	....	....	125
Netherlands	....	23	....	1,007
Belgium	....	210	....	712
France	1	1	17	2
Austria-Hungary	....	....	....	19
Java	19,235	....	32,055	7,420
United States of America	16,633	8,585	60,541	64,432
Argentine Republic	....	3	7	7
Mauritius	472	....	5,910	....
Other Countries	614	253	851	6,998
Total Refined Sugars	**36,955**	**9,076**	**99,381**	**80,724**
Molasses	8,733	3,725	42,139	35,807
Total Imports	**192,257**	**178,190**	**498,790**	**536,036**

EXPORTS.

	Tons.	Tons.	Tons.	Tons.
BRITISH REFINED SUGARS.				
Denmark	....	....	....	....
Netherlands	....	....	....	2
Portugal, Azores, and Madeira	....	....	....	....
Italy	....	....	....	....
Canada	....	....	....	....
Other Countries	17	4	315	98
	17	4	315	100
FOREIGN & COLONIAL SUGARS.				
Refined and Candy	....	180	132	656
Unrefined	1,581	3	1,650	1,236
Various Mixed in Bond	....	....	....	....
Molasses	28	432	44	1,261
Total Exports	**1,626**	**619**	**2,141**	**3,253**

Weights calculated to the nearest ton.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1920. Tons.	1919. Tons.
Total Receipts January 1st to April 22nd	1,045,116	939,425
Deliveries ,, ,,	1,045,116	939,425
Meltings by Refiners ,, ,,	982,000	841,000
Exports of Refined ,, ,,	155,000	110,000
Importers' Stocks, April 22nd	—	—
Total Stocks, April 22nd	73,548	109,915
	1919.	1918.
Total Consumption for twelve months	4,067,671	3,495,606

Beet Crops of Europe.

(Willett & Gray's Estimates to April 15th, 1920.)

	Harvesting Period.	1919-20. Tons.	1918-19. Tons.	1917-18. Tons.
Germany	Sept.-Jan...	750,000	1,411,900	1,541,061
Czecho-Slovakia, Hungary and Austria	Sept.-Jan...	600,000	700,000	668,250
France	Sept.-Jan...	155,000	110,096	200,265
Belgium	Sept.-Jan...	125,000	75,000	131,000
Holland	Sept.-Jan...	230,000	173,436	199,295
Russia (Ukraine, Poland, etc.)	Sept.-Jan...	350,000	700,000	1,028,580
Sweden	Sept.-Jan. .	150,000	127,467	125,000
Denmark	Sept.-Jan...	160,000	144,600	136,800
Italy	Sept.-Jan...	150,000	100,000	100,000
Spain	Sept.-Jan...	120,000	135,000	134,955
Switzerland	Sept.-Jan...	4,000	4,000	4,000
Bulgaria	Sept.-Jan...	15,000	16,000	22,000
		2,809,000	3,697,499	4,291,206

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR FOUR MONTHS ENDING APRIL 30TH, 1913, 1919, 1920.

	IMPORTS.			EXPORTS (Foreign).		
	1913. Tons.	1919. Tons.	1920. Tons.	1913. Tons.	1919. Tons.	1920. Tons.
Refined	257,090	99,381	80,724	379	132	656
Raw	320,077	357,270	419,505	1,017	1,650	1,236
Molasses	45,165	42,139	35,807	91	44	1,261
	622,332	498,790	536,036	1,487	1,826	3,153

	HOME CONSUMPTION.		
	1913. Tons.	1919. Tons.	1920. Tons.
Refined	247,800	89,471	87,036
Refined (in Bond) in the United Kingdom	232,735	263,235	220,405
Raw	35,307	100,162	113,608
Molasses	10,330	18,541	14,282
Molasses, manufactured (in Bond) in United Kingdom	13,786	24,796	26,717
Total	539,958	496,205	462,048
Less Exports of British Refined	8,836	315	100
	531,122	495,890	461,948

Sugar Market Report.

Our last Report was dated 12th April, 1920.

The Royal Commission has made no alteration in the price of 80s. duty paid for Granulated, Crushed and White Pieces supplied for domestic consumption, but owing to the further important advance in World's sugar values, 150s. per cwt. duty-paid has been fixed as the maximum price for "free" sugar and for Government allocations to all manufacturers, jam manufacturers being now included. The announcement of these alterations was made on 19th April, and was followed by a lively demand, which quickly absorbed the small available balance of "free" White Sugar on the Spot at prices ranging from 140s. to 148s.; West India Crystallized descriptions were also freely contracted, up to 134s. being paid. Immediate demands having been satisfied, prices for the latter have eased off a few shillings per cwt.

The rising tendency in the Cuban market has continued practically without interruption, and the f.o.b. quotation, which stood at 16·00 cents at the date of our last Report, is now rather above 18·00 cents. Mr. Himeley has come into line with other statisticians by reducing his crop estimate to 3,925,000 tons. Private reports from the Island suggesting a total of only 3,750,000 tons are not regarded seriously, although the early closing down of several factories, with results well below their own original estimates, tends to support the anticipation of a very disappointing crop. America, in her anxiety to acquire supplies, and not content with her large Cuban purchases, has bought largely from Java and the Philippines, whilst not despising small miscellaneous offerings from world-wide quarters. It is roughly estimated that recent sales of Java White Sugars to America approximate 150,000 tons, mainly for direct shipment over July, August and September, but comprising also some 20,000 tons for early shipment from India, out of existing stocks there.

Business in the Java market has concentrated almost entirely on the American enquiry just referred to, prices paid by the U.S. having been recently well above those obtainable in other quarters. The earliest contracts in White Javas for Autumn shipment direct to U.S. were effected on the parity of about 85s. c.i f., but an advance to 107s. has since been recorded. For early shipments from India, principally May, sales are reported up to the equivalent of 117s. c.i.f. Latest advices from Java are strong, with nominal f.o.b. quotations as follows:—June 65·00, July 63·00, August 60·00, September 57·00 guilders per picul of 136 lbs. English.

Latest advices regarding the prospects of European Beet production for next campaign afford but little amelioration. From Czecho-Slovakia it is now reliably reported that an extension of sowings of from 5 per cent. to 8 per cent. may be reckoned upon, as against earlier anticipations of a rather substantial reduction. The hope is expressed that, with favourable weather, an exportable surplus of 4/500,000 tons may be attained, which, however will be largely drawn upon by German-Austria, Jugo-Slavia and the Balkans generally. Mr. F. O. Licht speaks of an extended acreage of 40/50 per cent. in Belgium and 30/40 per cent. in Holland, and given normal weather, these increases should yield collectively an extra 150,000 tons. As regards Germany, private advices appear to confirm Mr. Licht's estimate of about 10 per cent. larger sowings, and a possible crop of 900,000 to 1,000,000 tons, which, it is claimed, will not suffice to cover home requirements.

The urgency of continued Government control becomes more insistent as the general world position is revealed. Prices have reached such a dangerous level that market risks entailed and the onus of finance are too serious to be undertaken by the private trader, even to the extent of supplying a quite moderate percentage of the country's needs.

H. H. Hancock & Co.

10 & 11, Mincing Lane,
London, E.C. 3,
7th May, 1920.

THE

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Notes and Comments.

The Jump in Sugar Prices.

A shortage in the current Cuban sugar crop of at least a quarter of a million tons (Guma & Mejer now put the probable total at 3,650,000 long tons) has had its natural results. Cuban sellers the last month or two have hardened with regard to their prices, and as a consequence the latter have risen till 25 cents per lb. has been touched. But America seems bent on getting sugar at any price, and as the consumer there is willing to pay even 38 cents (nominally 1s. 7d.) per lb. for domestic sugar, it is not surprising that what sugar supplies are available are going largely in that direction. The Royal Commission for the Sugar Supply have, we understand, secured all the sugar they set out to get for the 1920 ration in this country, but they have not escaped the tail end of the storm and have had to pay more recently a price which, it is officially stated, would involve a loss for the current year of £20,000,000 to the Treasury if the last retail price of 10½d. per lb., were continued. As the country has had enough of food subsidies by now, a further rise in prices has followed and sugar is now retailed at the following rates: Castor and Icing, 1s. 2¾d.; Cubes and Loaf Sugar, 1s. 2½d.; Granulated, 1s. 2d.; Muscovados and Raw Browns, 1s., all per lb. But the public are warned that this is only a temporary expedient and that further rises are in store, their date depending on how the Royal Commission's profit and loss works out. For the moment 1s. 9d. per lb. threatens to be a possibility in the near future. But the crux of the situation for this country will be when the negotiations for the next crops—those of 1920-21—take place. Here, unfortunately, the outlook is somewhat gloomy. The long drought, which has upset the calculations *re* the 1919-20 Cuban crop, is also affecting the growing cane for the 1920-21 season, so there does not at present appear to be much prospect of any record harvest such as the Cuban planters would be only too glad to secure. The Java crop is also not up to expectations, and we understand that it has already been virtually bought up by British, American, and Eastern buyers. It is to these two countries that we and America must continue to look for our main sources of sugar supply; the other sources at most only eke out our demands. It is becoming increasingly apparent that the supply is not going to be anything like equal to the demand. Nor will it be for some years to come. The only point to be settled is: Is the United States going to take the lion's share of the visible supplies or will some restrictions be put on United States consumption?

The fact is, so long as we in this country are restricted by rationing to a limited stock of sugar, while in the States the public are free to bid any price they like to secure sugar, there can only be one outcome; the bulk of the sugar will go to America and will be attracted there not only from Cuba and Java, but from every petty source that manages to spare a quantity of sugar to export to the American market on such favourable terms. In this country the Government have seen fit to reduce the consumption to the present meagre level and keep it there rather than allow the country to spend an unlimited sum in importing dear sugar to the detriment of the rate of exchange. We have still to keep a tight hand on our imports so long as the exchange works so strongly against us. In America, on the other hand, no such necessity exists, and the Government have left the sugar market free to deal as it chooses, at whatever price that is quoted by the sellers, with the sole proviso, we believe, that no profiteering at the expense of the domestic consumer is to be countenanced. If the American Government continue to pursue this policy, then it would appear that all the world outside of the United States will have some difficulty in securing supplies of the next crop. But should they, on the contrary, inaugurate some form of rationing and so curb the excessive demand of their citizens for sugar, matters will be equalized somewhat and the rather scanty supplies will more easily go round. Europe, especially the United Kingdom, will naturally hope that such rationing may be possible in the near future, and reports have it that such a step is contemplated. The decision rests with the United States Government and people, but one can at least express the hope that while there is a world's shortage of sugar, it may be possible for the whole world to come to some agreement to ration it out rather than let it be largely cornered by one or two nations.

British and American Sugar Consumption: A Query.

A writer to the *Times* who remains anonymous but is accorded the large type given to important writers of communications in that journal just lately raised the question of the real sugar consumption in the United Kingdom and United States. His main object seemed to be to deprecate the spreading of "questionable estimates of what the demand is likely to be" in those respective countries. He questioned whether it was actually the case that America's sugar consumption during 1920 was to be as high as 102 lbs. per head or 76 per cent. higher than our 58 lbs.—these being figures that he had seen published. He desired information as to how these estimates were arrived at.

He pointed out that the official figures for 1919 are for sugar *qua* sugar and do not include the sugar imported in confectionery, jams, tinned fruits, etc., and he suggested that to give a true picture of the sugar consumption of the two countries the sugar content of these other foodstuffs should be added. For the purpose of comparison he takes the percentage of sugar in these foodstuffs as 50 per cent. and on this assumption he argues that in 1919 America's net import of sugar in these forms was 8 lbs. per capita and that of the United Kingdom 14 lbs., in which case the total consumption of the two countries in 1919 would be nearer 98 lbs. and 90 lbs., a difference of but 9 per cent. So why a 76 per cent. difference in 1920? But the *Times* writer fails to see that it is not a mere question of inclusion or exclusion of foodstuffs, for so long as we are varyingly rationed in this country and they are not in America, there is no basis of comparison between the respective consumptions in 1919 and those foreshadowed in 1920. It does appear probable that thanks to the more restricted rationing now in force as compared with last year we shall not have a greater per capita consumption in the United Kingdom than 50 to 60 lbs., whereas in America there are no restrictions on consumption and indications all point to a record demand being made by the American public, largely we believe owing to their increased resort to soft sweet drinks.

The one point of value this correspondent has raised seems to us to be the question whether the sugar imported in sweet foods should be accounted for in the estimates of consumption. So many factors enter into these estimates that it is difficult to be more than approximate in one's calculations. Molasses for example (which the *Times* writer erroneously assumes is equivalent to sugar, pound for pound) is not entirely used for dietetic purposes, being also employed in commercial manufacture, *e.g.*, in making alcohol, bootblacking, etc. Hence there are bound to be errors which it would be futile to attempt to eliminate. But it might be possible to ascertain how much of the sugar entered as consumed in America actually gets shipped to Europe as the sweetening medium in canned foods. We take it that the American official figures of consumption only make allowance for re-exports of sugar *qua* sugar and do not attempt to account for the sugar gone out of the country in canned food. Some day when the world's sugar supply is once more adequate, and consumption is free in both the United States and the United Kingdom, the question as to which has the actually bigger consumption may well hang on the point whether a proper calculation of the sugar contained in the exported or imported foodstuffs has been made.

Meanwhile we note that the secretary of the British Manufacturing Confectioners' Alliance has been complaining in the press that while sugar-using manufacturers in this country are prohibited from importing sugar on their own account, there is no prohibition on the imports of goods containing sugar. In 1919 no less than 34 per cent. of the confectionery exported from the United States came to this country, its value being $4,218,876. There certainly seems a legitimate grievance here.

Australian Affairs.

At a conference held in Sydney last March, attended by canegrowers, millers, sugar workers, and representatives of the Commonwealth and Queensland Governments, an agreement as to the price of sugar was arrived at and was subsequently submitted to Parliament, by the Prime Minister (Mr. HUGHES). In the House of Representatives the latter made a statement with regard to the sugar industry in which he explained the conditions of the agreement. Either the Goverment must come to some such agreement or else relinquish control of the sugar industry. He affirmed that owing to the increased cost of production, and the rise in wages which represented 80 per cent. of the additional cost, the price of sugar must be increased from £21 to £30 6s. 8d. per ton for 94 per cent. net titre sugar. It was considered that the increased amount should be allotted as follows: £4 per ton to the sugar millers, and £5 6s. 8d. to the cane growers on the basis of the existing price of £1 10s. 6d. per ton of cane of 12 per cent. Commercial Cane Sugar contents. The agreement which is for three years was passed by the House.

We learn that there was general satisfaction expressed in sugar circles in Queensland over the agreement; and as it is intended to distribute the increased price in a very fair ratio, the change will undoubtedly prove of substantial assistance to sugar people during a very critical period. General satisfaction was also expressed by the canegrowers at the retention of the Sugar Cane Prices Act, for which the representatives of the United Cane Growers Association were responsible. As the millers were also satisfied, it would appear that Mr. HUGHES has been pretty successful in appeasing all parties, while accomplishing a satisfactory business deal for the Commonwealth.

The Uba Cane.

Much has been written recently on the origin of the Uba cane, especially by Dr. BARBER and Mr. NOËL DEERR. The former is satisfied that it is an Indian variety while Mr. DEERR inclines to the probability that the name originated in Brazil (whence the cane had penetrated from the Old World) and was merely the local term for a reed (*vuba or viba*). Now come two fresh stories, one from Brazil, and the other from Natal, which may throw some further light on the problem, though we must refrain for the present from any attempt to reconcile the various conflicting views or to summarize the position. One account comes to us from an old and esteemed subscriber to our journal, Mr. ALFRED J. WATTS of Pernambuco, whose knowledge of Brazilian sugar matters is probably as complete as that of any other student of the subject. His contribution (given on another page[1]) should serve as some useful first hand knowledge in elucidating the origins of this cane, and may prove a corrective to certain very recent views put forward in other quarters. The other story (also given elsewhere in this number) has just lately been published by an anonymous writer in the *South African Sugar Journal*, but it appears to be merely a variation of the story we gave three years ago in our pages,[2] taken from a Jamaica official bulletin, where the introduction of the Uba into Jamaica was made the subject of some historical conjectures. Still it is worth placing on record, as a link in the somewhat conflicting chain of evidence. As this most recent Natal version takes us back some 35 years, it would seem as though the two accounts, the one collated by MR. HARRIS of Jamaica and the one now published in Natal have a common origin ; both at any rate claim that the name "Uba" resulted from an undecipherable label that arrived in Natal from India. But the Brazilian origin Mr. DEERR supports[3] is much older ; and Mr. WATTS while doubting whether the name was ever derived from "viba" (a reed) shows pretty conclusively that quite 50 years ago there was a "Ubá" cane grown in Brazil possessing the characteristics of the Uba as we now know it. Both Mr. Deerr's conjecture, if it can be proved to be true, and Mr. Watts' evidence, would appear to dispose of the Natal version of the origin of the name. It seems hardly likely that the latter could be a coincidence, unwittingly and independently arrived at through the accident of a misdeciphered label. Still it is just possible.

While on the subject of this particular cane, it may be remarked that, according to our same contemporary, the Natal Estates, Ltd , have been experimenting for some years past with a sport of the Uba, first discovered on one of their estates. It has been cultivated carefully ever since and at the present time there are between 200 and 300 acres under cultivation. In appearance it is a purple-striped cane, rather closer between the internodes than the Uba and if anything less fibrous. The canes grow to about the same height and are inclined to be thicker than the Uba. The discovery in the opinion of our contemporary may be of considerable importance to the Natal sugar industry, as it is possible it may supply a substitute for the Uba. The Uba has now been cultivated for many years in Natal and as little or no attempt at selection has been practised, the cane has deteriorated; in some parts of Zululand it is becoming rather seriously attacked by disease, and there is always the fear that some day an epidemic may sweep through the canefields with disastrous results.

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[1] Page 326. [2] *I.S.J.*, 1917, 394 [3] *I.S.J.*, 1918, 161.

Although the description of this variety is somewhat meagre and inconclusive, we gather that it is a very hardy and vigorous grower and more capable of withstanding drought and disease than the older established Uba. The sport was found in a field of second ratoons and actually owes its existence to the intelligence of an Indian cutter who noticed its peculiar markings and drew the attention of the management to it. Canes were propagated from cuttings from the stool thus found, till now, as above stated, nearly 300 acres are under cultivation.

So far no separate crushing of these canes has been attempted, but the sugar content is said to be quite satisfactory. Later on, it is to be hoped, a full comparison will be made with the standard Uba by means of the usual chemical data; this is a work that could best be undertaken by expert investigators, and the case only serves to emphasize the lack of that necessary adjunct to a sugar industry which at present holds in South Africa, a fully equipped sugar experiment station.

Java Chemical Control Results.

In our May issue (page 271) we gave the *average* results of mill data in Java during 1919; but it has been suggested to us that the first two lines of that Table, giving the weight of cane ground, might be misconstrued as being the total for Java, whereas of course they are meant for the average weight *per factory*. As there were 69 "defecation," 54 "defecation-sulphitation" and 20 "carbonatation" factories, the totals for Java of cane ground should read—

	DEFECATION.	DEFECATION-SULPHITATION.	CARBONATATION.
Piculs	86,227,211	69,060,284	27,299,740
Long tons	5,247,450	4,197,850	1,659,440

Death of Mr. C. Sandbach Parker.

One regrets to have to record the death, after a severe illness of some eleven weeks, of a leading light in the British sugar world, Mr. CHARLES SANDBACH PARKER, C.B.E., which took place on May 9th. Mr. PARKER was actively interested in sugar both at home and in Demerara. He was a member of the Executive of the West India Committee, and was one of the original directors of the Demerara Company having been its managing director in London since 1908. In addition, he was one of the founders and the chairman of the British Empire Producers' Organization, and was also associated with the British Empire Sugar Research Association and with the Royal Colonial Institute. He made three attempts to enter Parliament in the Unionist interest but as he wooed a pronounced Liberal constituency he was unfortunately unsuccessful, and so the cause of British sugar was denied his advocacy in Parliament. Mr. PARKER leaves a widow and two daughters.

The Kelham Sugar Beet Estate.

We gather that the directors of Home Grown Sugar, Limited, have now decided upon their preliminary arrangements for the first crop of sugar beet to be grown in 1921 for the factory now in course of erection. In addition to the acreage to be grown upon the Kelham Estate, farmers in Nottinghamshire, Lincolnshire and neighbouring counties will be approached to grow a crop on contract.

The work in connexion with the production and supply of beet for the factory, including the farming operations upon the estate, has been allotted to a new Department under the supervision of Mr. SIDNEY COLYER, the present estate manager, as the Controller of Beet Production and Supplies. The extension, in addition to the factory, of a demonstration farm on extensive lines with sugar beet as its main crop will, in the opinion of the directors, assist not only in introducing sugar beet as a new crop among farmers in the district, but in establishing on a permanent basis an industry known to lead to the general improvement of agriculture.

Increased Subscription Rate.

Owing to the great increase in the cost of production in the publishing trade, which has followed the termination of the war, we are reluctantly compelled for the second time within three years to raise the price of our annual subscription, and from July onwards it will be 21s. per annum post free. In taking this step, we are faced by the fact that, as compared with the pre-war figure, printing and paper have gone up in cost in this country by amounts which, taking the average, are from 200 to 300 per cent. more. Then there is the question of postage which within the United Kingdom has lately been about 3d. per copy or 3s. per annum; under the revised postal charges inaugurated this month the same rate (under book packet conditions) is to continue for at least a few months longer; but both it and the overseas rate are to come up for consideration at the Postal Union Congress to be held at Madrid in October, and indications are that a substantial increase in both inland and foreign rates will be decided on at the Congress, unless it be agreed that the newspaper rate should be applied also to fortnightly and monthly journals, a concession that does not however seem very likely to be obtained.

In view of these facts it is impossible to continue the subscription rate at the present figure of 16s. post paid, if we are to continue to give our readers the same high class journal, let alone improve its features and enlarge it. We are therefore raising it to a rate just 75 per cent. above the pre-war figure. As it was recently remarked by Sir AUCKLAND GEDDES, formerly President of the Board of Trade, that in his private opinion post-war normal figures would eventually settle down somewhere round 75 per cent. over pre-war prices, it can hardly be suggested that our increased subscription is an excessive one. It will at least give us a fairer chance to offer our readers a good return for their money than the old subscription would do under present day conditions of high wages and high cost of paper, illustration blocks, and postages.

It may be remarked in conclusion that our action is only on a par with that of other trade and technical journals in this country, which have all been forced by the rise in costs of production to revise their charges. Increases vary according to the circumstances, but we note one of the leading engineering weeklies has increased its price by over 100 per cent. as compared with before the war, and a further increase may not be precluded.

A professorship of bio-chemistry is about to be instituted at Oxford University; and Mr. EDWARD WHITLEY, M.A., of Trinity College, has offered £10,000 towards the establishment of this chair.

Mr. E. R. MENDEZ, the manager of the Havana office of the S. S. Hepworth Company, of 2, Rector Street, New York, has elaborated a process of making white sugars by bleaching and washing. Syrup of a certain purity is treated with a bleaching agent and mixed with the hot massecuite, which is then machined and washed with saturated steam. It is stated that the product obtained by this procedure rivals refined sugar.

Fifty Years Ago.

From the "Sugar Cane," June, 1870.

Payen, writing in this issue, described the good results that were being obtained in France by the introduction of *râperies*, or rasping houses, in which the juice was extracted from the beet, and from which it was transferred by underground pipe lines to the central factory some miles away for elaboration to sugar. It appears to have been the idea of M. **Linard**, engineer to Cail & Cie., and the elimination of the cost of carting the roots which it made possible must have amounted to a very considerable sum when the total production was regarded. The first application of the system was made by the *usine* of Montcornet (l'Aisne), which laid down 5 miles of pipe lines, and it was followed by the Vanciennes (Oise) factory with 6½ miles. Plans were projected for the erection of 50 rasping houses, conveying their juice through 220 miles of piping, one of which *râperies* used 14 miles and another 19. **Linard** anticipated loss of sugar owing to the fermentation of the juice, by liming at the rate of 1 per cent., which indeed was found to prevent any alteration. The diameter of the lines varied between 2½ and 4 ins. During the spring it had been found practical to use these lines for conveying water from one district to another where it was scarce.

At that time presses were still largely used in the factory for the extraction of the juice from the rasped roots. They comprised a large proportion of the plant; they were costly to erect and to operate; and they required a staff of trained and robust workmen who were difficult to recruit. Efforts were, therefore, being made to ameliorate matters by introducing a cheaper and more practical system. Diffusion was coming into use; but in this number an article was reproduced from *La Sucrerie Indigène* dealing with the advantages of a method proposed by **Walkhoff**. Pulp rasped in the ordinary manner was allowed to fall into a continuous press by which a part of the juice was extracted; the residue was mixed with 25 to 30 per cent. of water of the original weight of roots, and again passed into the press, the pulp then remaining being almost entirely deprived of sugar in this way. Instead of obtaining 80 to 82 per cent. as in the method of pressing generally used at that time, 90 to 92 per cent. was obtained, and the labour involved was stated to be much lighter and the work much quicker.

Eisfeld's process of revivifying animal charcoal was described. As is well-known, instead of re-burning he proposed to digest the char after use in a solution of ammonia (or potash or soda), in order to dissolve the colouring matters taken up from the sugar which had been treated. An economical source of ammonia was stated to be the condensed water from the evaporators. Although this process of regenerating spent char was used to some extent on the Continent, it was only applied experimentally in this country.

Other articles were concerned with the nature of sugar obtained from juice by its concreting, clarifying loaves with *clairce* using pressure, absorption of salts by char, and the addition of alum to the limed juice; but none of these calls for special notice. No English patents were abstracted in this issue.

The Financial Transactions of the Royal Commission for the Sugar Supply.

The Select Committee on National Expenditure which issued a year ago a Report on the trading of the Royal Commission for the Sugar Supply down to March, 1918,[1] has now been able to consider the balance sheet of the Commission for the succeeding 12 months, that is to March 31st, 1919, and to issue a memorandum on the subject of the sugar supply for the consideration of Parliament.

"The balance sheet [the Committee report] shows a net estimated profit, from the commencement of the operations of the Commission in August, 1914, to 31st March, 1919, of £6,057,000. But it appears that during the year 1st April, 1919, to 31st March, 1920, the profit was reduced by the rise in the price at which sugar was purchased by the Commission and by the sale of sugar to the public at a loss equal to about £2,000,000. The operations for the year 1919-20 have, therefore, involved an estimated loss of about £4,000,000 for that one year alone.

"The world supplies of sugar are increasingly inadequate to the demand. Consequently, the price of raw sugar, f.o.b. Cuba, which, we are informed, rules the price throughout the world, has risen from 5·93 cents. per lb. (average price in 1919) to 18¼ cents. per lb. on 26th April, 1920.

"In order to avoid any loss to the State on the Commission's transactions for the current financial year, it is estimated by the Commission that, if the price charged to manufacturers continues to be based, as at present, on current market prices, the retail price to the domestic consumer would have to be 1s. 3d. per lb. This price is based on the assumption that the average cost of supplies for the year 1st April, 1920, to 31st March, 1921, will be approximately 1s. 1d. per lb., including duty, to which must be added the sum of 2d. per lb. to cover the costs of distribution, The present retail price to the domestic consumer is 10d. per lb. If this price is continued, the Treasury will be compelled to face, on the operations of the current year, a deficit on account of the Sugar Commission, on the existing basis of consumption, of not less than £20,000,000. In making this estimate, due allowance has been made for the presumption that sugar will continue to be sold to manufacturers by the Sugar Commission on the present basis.

"The Committee deem it their duty to bring these facts to the notice of the House of Commons immediately, and to warn the House that unless the price of sugar is advanced without delay, a large sugar subsidy is inevitable. As to the propriety of such a subsidy, the Committee are, by the terms of their reference, precluded from expressing an opinion; but they would fail in their duty to the House of Commons did they not warn them of the serious financial consequences of such a policy.

"They desire, further, to express the opinion that if the price of sugar is now advanced it should be made clear to consumers throughout the country that the increase is due, not to any "profiteering" on the part of the Sugar Commission, but to the shortage of world production and the enhanced price at which the Commission are purchasing the necessary supplies of sugar.

"Your Committee desire to call attention to the fact that the balance sheet for the year ending 31st March, 1920, has not yet been prepared, and that the balance sheet for the period from August, 1914, to March, 1919, was only completed a few weeks ago."

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[1] *I.S.J.*, 1919, 320.

European Beet Sugar Forecast.

(From our Continental Correspondent.)

Almost simultaneously we have received two estimates of the 1920-21 European sugar crop, which show rather large differences. One is the estimate of Messrs. WILLETT & GRAY, of New York, the other that of the editor of the *Journal des Fabricants de Sucre*, of Paris. We give them here in one table:—

	WILLETT & GRAY.	JOUR. DES FABS. DE SUCRE.
Germany	1,300,000	815,000
Czecho-Slovakia	580,000	800,000
Austria and Hungary	50,000	
France	250,000	275,000
Belgium	187,000	175,000
Netherlands	300,000	320,000
Russia, Poland, Ukraine, etc.	350,000	350,000
Sweden	160,000	178,000
Denmark	165,000	160,000
Italy	170,000	300,000
Spain	130,000	
Switzerland	5,000	
Bulgaria	15,000	
Total	3 820,000	3,215,000

It will be apparent that the figures of Messrs. WILLETT & GRAY are much higher than those of our Paris contemporary and, as last year, it is again the estimate of the German sugar crop which makes the largest difference. Last year Messrs. WILLETT & GRAY estimated this German crop for 1919-20 at 1,300,000 tons, while it only amounted to 745,000 tons; and this time their expectations of that crop are again much more optimistic than those of Continental statisticians.

In their issue of April 29th Messrs. WILLETT & GRAY publish the following:—"We have information from various sources within Germany and from other countries, and the generally accepted opinion is that the sowings will be increased about 20 per cent. Taking last crop sowings of 300,000 hectares of beets as a basis, and the poorest yield per hectare known (excluding last year when many thousands of tons of beets were abandoned) of 23,800 kg., on the sowings of 350,000 hectares expected for 1920-21 crop there would be produced in all certainty 8,000,000 tons of beetroots, and furthermore, using the lowest yield in sugar since 1914, the crop outturn will be 1,300,000 tons. In every instance we have used the poorest yields since 1914, and if political conditions continue favourable and sufficient coal is obtainable, this figure will be the minimum. Under favourable conditions an increase of 100,000 tons to 200,000 tons above this figure of 1,300,000 tons is not unreasonable."

The *Journal des Fabricants de Sucre* confines itself to the following dictum:—"In Germany no larger extension of the sowings is expected beyond 10 per cent., and on this basis, all conditions remaining unchanged, we may expect 815,000 tons instead of the 750,000 tons of 1919-20."

Since these two widely differing forecasts were published, the results have become known of the inquiry held by the Association of the German Sugar Industry among its members. It reveals that 280,207 hectares have been planted by the sugar manufacturers and their contractors against 270,125 in 1919. This means an increase of only 3·7 per cent. or much less than the one foreseen by the

Journal des Fabricants de Sucre and correspondingly less than that of Messrs. WILLETT & GRAY. Mr. LICHT of Magdeburg believes that over and above this area a small amount of land may be sown by speculators, and he takes the German sowings of 1920 at 285,000 hectares at the most. Further, he makes the following calculations in his weekly report of 21st May:—

"The sugar production to the hectare has been in Germany as follows in recent years:—

YEAR.	KG.	YEAR.	KG.
1919-20	2731	1913-14	5106
1918-19	3665	1912-13	4989
1917-18	4090	1911-12	2983
1916-17	3891	1910-11	5453

With a crop as in 1919-20 Germany could produce 778,000 tons as compared with one in 1910-11 of 1,554,000 tons. When, however, we take into account the lack of fertilizers which has ruled during the past six years, the scarcity of labourers and their unwillingness to do strenuous work, the cessation to Poland of the best beet producing regions, and the manifold difficulties connected with doing regular work, we cannot expect a better yield per hectare than that of 1917-18 and the 285,000 hectares, producing on an average 4090 kg. to the hectare, should yield a crop of 1,165,000 tons."

These data show that the American estimates are too high, because they expected an area of 350,000 hectares, which is 70,000 hectares over the result of the enquiry. The sugar production to the hectare is assumed at 1,300,000: 350,000, or 3711 kg., which is not at all exaggerated and is surpassed by Mr. LICHT's hypothesis. The French estimates are too low, as they assume as bad a result as in 1919-20, which need not be expected, since the latter was occasioned by the early frost and heavy snowfall in the first days of November 1919, at a time when a great proportion of the beets were still standing in the field. Such a contretemps would not be expected two years running and therefore the production of sugar to the acre in 1920-21 need by no means be so bad as in the disastrous year which has just closed.

The same observation may also be made for Czecho-Slovakia. The area sown there with beets is only 6 per cent. over that of 1919, but it is not right to simply increase the estimate of the sugar crop by that figure too. The production suffered greatly by the adverse meteorological circumstances at the beginning of the winter which considerably decreased the sugar crop. As this should not re-occur, we may safely increase the estimates of the Czecho-Slovakian republic and fully agree with those of Messrs. Willett & Gray.

Mr. LICHT publishes the following data on the European sowings for 1920-21 together with those of last year.

	1920-21	1919-20
Germany	285,000 hectares.	271,000 hectares.
Czecho-Slovakia	195,000 ,,	185,000 ,,
France	100,000 ,,	70,000 ,,
Netherlands	66,000 ,,	49,538 ,,
Belgium	48,000 ,,	34,000 ,,
Sweden	42,000 ,,	34,210 ,,
Denmark	38,500 ,,	40,500 ,,
Poland	50,000 ,,	45,000 ,,
Other countries excluding Russia and Ukraine	195,000 ,,	172,000 ,,
Total	1,019,500	901,248

European Beet Sugar Forecast.

The prospects of the crop are good everywhere in Europe, in many places even excellent, and as the coal supply has begun to improve, it makes us confident to give the following forecast of the coming crop, it being understood that our figures are the maximum ones which may be attained if no uncommonly bad weather does harm to the crop and in case no political disturbances or warfare prevent the crop from being worked up properly.

	SUGAR METRIC TONS		SUGAR METRIC TONS
Germany	1,000,000	Sweden	180,000
Czecho-Slovakia	800,000	Denmark	160,000
Austria and Hungary	50,000	Italy	170,000
France	275,000	Spain	125,000
Belgium..	175,000	Other countries	25,000
Netherlands	320,000		
Russia including Poland, etc.	350,000		3,630,000

Sugar Cane Seedling Work in India.

By Dr. C. A. BARBER, C.I.E.

PART II.

In the previous paper on this subject[1] the early work of the Cane-breeding Station was referred to. It was pointed out that the raising of cane seedlings for India was a very different problem from that usually presented for solution in tropical conditions, as the class of seedlings so easily raised from ordinary thick canes was, as a whole, quite unsuitable for the great mass of Indian cultivation. What was needed was a series of thin, hardy canes, capable of withstanding a good deal of neglect, not requiring much manure and, in places, frost and drought resistant, and generally better in richness and yield per acre than the varieties grown in the different provinces. As these latter vary a great deal in their requirements it was soon recognized that seedlings of different parentage and character had to be raised for the separate tracts. Such seedlings would naturally be obtained most readily by crossing indigenous Indian canes with tropical ones. This aim has been consistently held in view at the station since its inception, and the difficulties encountered and the way in which they have been overcome have been discussed. In the prosecution of this work the cane arrows and the seedlings obtained from them were exhaustively studied, easy methods were devised for determining male and female fertility of the arrows dealt with, the degree of flowering of different groups of cane were detailed together with the times of flowering and the general character and degree of development of the arrows in the different classes. Having thus dealt with the preliminary spade work, we can proceed to describe the results obtained in seedlings raised by crossing definite parents, themselves possessing the desired qualities.

Crosses of definite parentage.—Crosses of known parentage are not easy to obtain in the sugar cane, and this difficulty has been accentuated in our case by the untimely arrowing of the desired parents, as mentioned in the previous article. It was early recognized that in the heavy monsoon weather of the flowering season at Coimbatore any form of emasculation was out of the question, and this was the more readily agreed to because of the lack of success in those places, such as Barbados and Cuba, where this method had been most carefully prosecuted. On the Cane-breeding Station our attention has been focussed on various lines of indirect attack which have ultimately been crowned with abundant success. Dominating all these efforts is the selection of fertile-styled, pollen-sterile mothers. This method has been steadily held in view since the foundation of the station and, with the exception of the use of open anthers to determine male and of starch-laden styles female fertility, contains nothing new. The 400 crosses obtained in 1912 between Shakarchynia and *Saccharum spontaneum* were of this character, as the stamens of the former were unopened. The question as to which characters of the parents are observable in the seedlings has from time to time received a good deal of attention, but more pressing work has prevented anything being published on the subject; some few results will however be referred to later. In 1913 a set of 200 seedlings were obtained by crossing Vellai as mother with *Saccharum Narenga*, a grass from North India which never forms solid canes, the flowering branches being thrown high into the air on a soft reed-like axis which disappears completely after the flowering is completed. The cross was an extreme one, and as detailed above all attempts to use the seedlings as parents have been unsuccessful because of the complete sterility of the masses of flowers which appear every year at a most conveniently early period. But this material was considered ideal for the study of the relative inheritance of the parental characters in a first cross, and much time has been at intervals spent on their examination. Nothing has however been published beyond a fine series of plates showing the main vegetative and flowering characters of the parents and the crosses obtained (see two of these Plates reproduced in the last article). Meantime detailed analyses have been made of the canes of varying length produced in the different seedlings. These seedlings are grown on year by year as an interesting demonstration, and in the hope that at some time their fuller examination may be taken up. Similar isolated pieces of work have been done on selfed seedlings of *Saccharum spontaneum* and on the Shakarchynia, Chin and Vellai crosses with *S. spontaneum*, and many of the seedlings here too are being grown on year by year and have been analysed. The results of these studies are recorded in the office files at Coimbatore.

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[1] *I.S.J.*, May, 1920, pp. 251-257.

Some of the accumulated data in our study of crossing may be of interest. The following have proved to be pollen sterile in varying degree at the station:—Vellai, Ponda, Fazuliganj Paunda, Phear's Green, Green Mauritius, Mauritius 1237, J.36, J.213, P.O.J.100, the whole Pansahi group including two varieties received from Japan, Katara, Kinar, Mojorah, Dhor, Hotte Cheni, Putli Khajee, Dhaur, Ekar, Rakhra, Kassoer, and a number of our own selected seedlings. To illustrate the facts which have been of use in forming our conclusions as to the correctness of this method, the following have been extracted from the mass of data accumulated. In all cases where crosses are attempted and in many general unbagged collections a simultaneous sowing of selfed arrows from the same mother is made as a check:—In Vellai 40 pans of arrows produced no seedlings while, at the same time, this cane crossed with *Saccharum Narenga* gave 200 seedlings in one pan. Pansahi selfed and unbagged both gave no seedlings in 40 pans, whereas 2 pans of arrows crossed with Saretha gave over 60. Chittan unbagged gave 12 seedlings in 6 pans, while when crossed 27 pans gave 1200 seedlings. Mauritius 1237 selfed gave 2 seedlings in 4 pans, when crossed 900 seedlings in 10 pans. Six pans of J.213 selfed gave 2 seedlings, while 50 pans of crossed arrows gave 10,000.

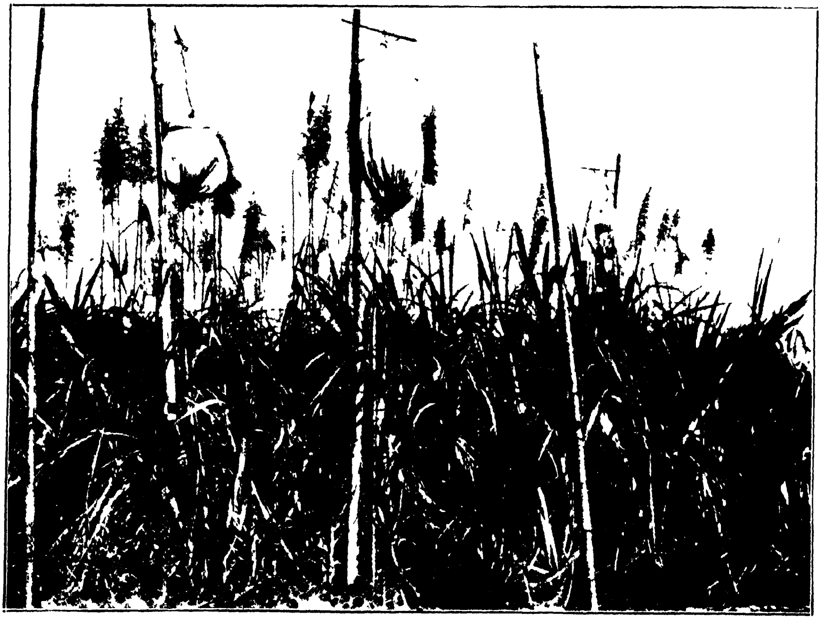
Although it has been a constant source of trouble that Vellai, the best local acclimatized cane, flowered so early, we may perhaps trace much of our subsequent success to this very fact, for it necessitated a much fuller study of the whole question, some of the details of which study have been given in the present articles. A good number of suitable mothers are now known, without pollen and with starch-filled styles, and the number of these is being continually increased. As a result, large numbers of undoubted crosses are now being obtained every year, between the thin indigenous Indian canes or our own seedlings having

PLATE I.

Two Karun Seedlings (1912-14) showing marked difference in general habit at maturity

PLATE II

Madras Seedling No 3017 arrowing



Method of selfing or crossing Arrows Crosses are effected by blowing in Pollen each day from below, and immediately covering up again similar characters and thick tropical canes of good quality. In the following table some of the annual results of the work are set down, as completely as it is possible at this distance from the office records.

Seedlings and Crosses at the Cane-breeding Station, Coimbatore.

	Seedlings obtained.	Crosses of desired Parentage.	Grown to Maturity.	Of type suitable for North India.	Selected for North India.	Distributed after Trial.
1911	60	less than 300	48	31	0	—
1912	10,000		2067	417	3	—
1913	22,000		2400	200	4	—
1914	20,000		3400	1340	10	—
1915	30,000		4100	2100	15	—
1916	99,000		4800	3400	150	—
1917	75,000	4000	4700	4000	(200)	—
1918	10,800	(5000)	(4300)	(4000)	(200)	16

Figures in brackets are not accurate. The numbers grown to maturity and selected for North India are strictly limited by space and staff available. A constant process of weeding out takes place in the latter. The first distribution took place early in 1918 to 14 stations in various parts of India; reports on these are encouraging. 350 different combinations were attempted in 1917-18 with 30,000 resulting seedlings; in 1919-20, 240 combinations produced 40,000.

In a letter received a short time ago from Mr. Venkataraman, who is carrying on the work at Coimbatore, the following details are given of the seedlings obtained in October to November, 1919:—"The number of seedlings raised was again very large, and the seedling house had to be doubled in area to contain them. Among the crosses obtained the following are the most interesting:—Vellai by *Saccharum spontaneum* and by our own thin seedlings, 2500; Chittan by thin crosses, 1000; Green Sport of Striped Mauritius by thin crosses, 3000; J.213 crosses, 5000; Black Cheribon and P.O.J.100 crossed with various kinds, 1000; Kassoer crosses, 5000. It is confidently assumed that among these there will be many suited to North Indian conditions."

Notes on the methods adopted.—The bags employed are 5 ft. long and 2 ft. 8 in. across; they are made of the finest muslin, locally called "mull"; this is practically pollen proof, although experiments have shown that in heavy winds pollen can pass to a limited extent. The cylindrial cages around which the bags are folded are 2 ft. 9 in. long and 1 ft. 4 in. in diameter; they were at first made of iron rods, but as this was proved to raise the temperature inside split bamboos were substituted, being rigid enough and much cheaper; a ring at the top and another at the bottom are joined by a number of upright pieces, thus preventing the muslin being blown against the inflorescence within. These precautions were found to be necessary with some of the more delicate arrows, such as those of Vellai. The cages are hung on tall bamboos by means of a gallows-like cross bar at the top; this cross bar is firmly fixed to the upright by means of a diagonal support; a rope tied to the upright bamboo slides over a small rounded bamboo at the top, and thus suspends the cage by a pulley arrangement so that it can be raised as the expanding arrow increases in length. The bags are placed over the arrows before they emerge from the enclosing leaf sheaths as some flowers have been found to open inside them. When the position of the cage is finally fixed it is kept in position by two smaller upright bamboos sunk in the soil, and the arrow stalk is tied to a smaller bamboo to prevent its movement inside the bag. The bags completely enclose the arrows, above, around and below, and are only opened below for the insertion of pollen for a few moments. They remain thus closed till the arrow is cut off when the seeds are ripe, this being judged by the commencement of the shedding of the flowers. (See Plate II).

The protrusion of the anthers in the flowers of the inflorescence proceeds regularly from above downwards. The basal flowers of the arrow have a lower percentage of open anthers, the highest percentage being at or near the top. This latter part is consequently used for the collection of pollen. The method of pollination has passed through a process of evolution as we gained experience. At first the plants it was desired to cross were planted in alternate rows, pollen-fertile kinds being placed next to pollen-sterile ones, and arrows brought together in the same bag. This was soon given up, as it was found that the arrows were extremely delicate and any unnecessary handling was liable to influence the fertility. The slightest bend in the long arrow stalk would render the whole arrow useless, this fact also helping to decide us against any attempts at emasculation. There was the additional difficulty that it was very problematical whether the two kinds would flower at the same time. The pollen arrows were therefore cut the night before and placed in two-pound jars of water and carried to the cages in the morning and hung over the arrows to be crossed ; a gentle tapping at ten o'clock freed all the pollen from the opened flowers. But this method was also given up in favour of collecting the pollen direct in the morning. It was gathered on tissue paper and carried to the cage and dusted over the arrow inside. Later it was found convenient to place it in small gelatine capsules such as can be obtained at any chemist's. It was found important that the pollen should be thoroughly dry, as otherwise, in quantity, it tended to collect into little balls and this greatly impeded the work. Gently sunning or warming it and passing it through fine meshed cloth proved effective. A further economy both of pollen and labour was effected lastly by placing the dried pollen in a larval-blowing apparatus and dusting the arrow inside the cage by this machine ; after each operation the inside of the machine could be easily and quickly sterilized. Sometimes pollen of the desired type was scarce and it was found by using this instrument that as many as three arrows could be completely dusted by the pollen collected from one. It was in the earlier period attempted to send pollen by post in the gelatine capsules, but this was not continued because the farm rapidly became self contained as to male parents. The pollen arriving was often caked and difficult to use, and we subsequently learned that this was due to insufficient drying. Trials as to the length of life of the pollen were unsuccessful except in the case of *Saccharum spontaneum* where it was still capable of germination after 14 days.

It was repeatedly noted that unbagged arrows gave better germination than bagged ones at the same time and place. This was probably due to the high temperature inside the bags, for this was found to be sometimes 10 degrees higher than outside, and it had sufficient influence on delicate varieties to interfere with fertilization. Among other observations it may be noted that arrows from ratoon crops showed a higher degree of fertility in the male organs. This was of special importance in the usually pollen-sterile parents which, when ratooned, often had many opened anthers; ratoons of such canes were therefore discarded. The early canes of a plant were also found to have fewer open anthers than the late formed ones, and this observation also assisted us in the crossing work.

General study of cane seedlings.—Concurrently with the study of arrowing and the production of seedlings, the latter were subjected to detailed study. Some of the results of this have been presented in a long Memoir (1916, 97 pages and 29 plates). It is obviously impossible to enter into this work here in any detail. To indicate the subjects dealt with in one section of the Memoir the following quotation has been taken from the Introduction : "One of the most striking features in any batch of young seedlings, raised from common parents, is the variation among them in small particulars. This is true of cane seedlings as well as of other plants. They differ in size and shape, width of leaf and thickness of stem, colour marks in various parts and habit in general. As to the latter, the seedlings may vary from upright bushes to oblique, sprawling or prostrate. The tips of their leaves may be strict, erect, rapier or bayonet-like in their rigidity, sharply bent or curving broadly and gracefully. The colour of the stems may be yellow, green or white, tinged with pink, purple, red or claret, striped in various ways (though very occasionally so), shiningly smooth or thickly coated with white waxy bloom. The leaf sheaths are less easy to describe, but here too we find all gradations in colour between light green and dark chocolate purple, through various stages of reds and blues." (See Plate I.) All of these characters are discussed in the body of the paper. A special section is devoted to the earlier phases of the chemical analysis of the juice. It was soon observed, that in any batch of crosses, although the richness of the individual seedlings varied within wide limits, the average of all (if of sufficient number) is almost exactly equal to the average of the two parents. Special study has been made of the means by which the heavy analytical work can be quickened and a large number of seedlings thus dealt with each year, and a series of petty analyses are made some time before crop. One of the methods investigated is described as "up to dead leaf" analysis. Assuming that each cane plant is made up of a number of superposed segments or phytomers, and building on the known fact that the cane ripens from below upwards during its growth, the part of the cane below the uppermost dead leaf was early subjected to a separate analysis and the use of this method was found to throw a good deal of light on the subsequent value of the seedling. By various adaptations and rearrangements it has now become possible to deal with a much larger number of seedlings each year in the laboratory than at the commencement of the work.

In the Memoir referred to a first attempt has been made at the study of correlations between the external morphology of the cane plant and the richness of its juice. Ten blocks of seedlings were selected in 1914 for this work, chief among which were 477 Chittan and 323 Karun seedlings, both of these parents being thick tropical canes which had long been acclimatized at Coimbatore. It was considered advisable for this work that seedlings of different parentages should be studied separately, and this was done, most attention being directed to those blocks where the largest number of seedlings were available. The results in these large blocks were very uniform while some of the smaller lots, in which the lowest number was 13, gave less reliable figures. It was ultimately assumed that at least 50 should be examined and preferably 100. The results in these two larger blocks, usually borne out by the smaller ones, were that there appears to be a very definite negative correlation between leaf width and leaf length and richness of juice; the module of the leaf (length divided by width) gave an equally definite positive correlation, as did the length of the cane; thickness of the cane yielded no definite results, but there seemed to be an inclination for the thinner varieties to have a richer juice. These results may have some bearing on the oft observed antithesis between vigour and sucrose content. Since this Memoir was published a vast number of additional observations have been made by Mr. VENKATARAMAN, but there has not been the opportunity to work up the results. It is obvious that if such relations could be generally established, the work of selection of seedlings would be greatly lightened.

Isolated observations were made upon the inheritance of parental characters (besides those referred to in a former paragraph). In Ashy Mauritius seedlings the shape of the joint appears to be inherited; other inherited characters are the circlet of hairs below the leaf scar and the colour of the growth ring. The colour of the joint on the other hand does not seem to obey any general law, although sometimes there is a distinct tendency of the seedlings to approximate to the parents. Striped canes when selfed or crossed produce one-coloured seedlings, even fewer striped seedlings having been observed among their progeny than in those of certain one-coloured canes. Generally speaking, in the ten cases examined above about half of the seedlings were green, whatever the colour of the parents may have been. The subject is an interesting one but has its own difficulties, for the number of nuances is very great and in no case has the personal factor of the observer to be more carefully checked.

List of publications.—According to local procedure most of the work done on the Cane-breeding Station is contained in the quarterly reports presented to the director, and these are not published. A yearly summary is however to be found in the printed Report of the Madras Agricultural Department*, and the years 1912 to 1919 may be consulted. Annual summaries may also be found in the Report on the Progress of Agriculture in India, that of the Board of Scientific Advice, and the Proceedings of the Board of Agriculture, in which latter publication much other information on the sugar industry may be found. The following individual papers have been prepared by workers on the station, all of which, excepting the last, are officers of the Cane-breeding Section.[1]

Memoirs of the Department of Agriculture in India.

Studies on Indian sugar canes, by C. A. Barber.

No. 1. May, 1915. Punjab canes.

*No. 2. July, 1916. Sugar cane seedlings, including some correlation between morphological characters and sucrose in the juice.

No. 3. May, 1918. The classification of Indian canes with special reference to the Saretha and Sunnabile groups.

No. 4. July, 1919. Tillering or underground branching.

No. 5. August, 1919. On testing the suitability of sugar cane varieties by a system of measurements. Periodicity in the growth of the sugar cane.

**Annals of Applied Biology*, January, 1915. Some difficulties in the improvement of Indian sugar canes. C. A. Barber.

Report of the International Congress of Tropical Agriculture in 1914. C. A. Barber.

The sugar cane in India.

Classification of Indian canes.

Bulletins of the Research Institute at Pusa.

No. 83. 1919. The progress of the sugar industry in India during the years 1916 and 1917, with an introduction by C. A. Barber.

*No. 94. 1920. A preliminary note on the behaviour in North India of the first batch of sugar cane seedlings distributed from the Cane-breeding Station at Coimbatore. T. S. Venkataraman.

Agricultural Journal of India.

*1912. Vol. VII, part IV. Sugar cane seedlings in India. C. A. Barber.

1915. Vol. X, part III. Sugar and the sugar cane, being the opening address in the botanical section of the Indian Science Congress, 1915. C. A. Barber.

1916. Vol. XI, part IV. Classification of indigenous Indian canes. C. A. Barber.

*Vol XI. Special Congress number. A study of the arrowing of the sugar cane with special reference to selfing and crossing operations. T. S. Venkataraman. Study of sucrose variations in successive joints of the sugar cane. T. S. Venkataraman and K. Krishnamurti Row.

1918. Vol. XIII, part II. Testing new cane seedlings in North India. C. A. Barber.

1919. Vol. XIV. Special Congress number. The effect of salinity on the growth and composition of sugar cane varieties. K. Krishnamurti Row. Studies in the chemistry of the sugar cane. B. Viswanath.

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[1] These papers do not all of them deal specifically with the raising of seedlings, but few of them do not refer to them incidentally or to the characters of their parents. Those of most moment in our present study are denoted by an asterisk.

The Growth of the Sugar Cane.[1]

By C. A. BARBER, C.I.E., Sc.D., F.L.S.

VI.

The early stages of growth in a cane field have, as is natural, always received a great deal of attention from planters. The writer well remembers the first time he planted a field of sugar cane and the occasional panic which seized him before the full set of young cane shoots appeared above the ground. He had, greatly daring, attempted to introduce the West Indian practice into one of the great deltas of Peninsular India.

Everyone is aware that the plants may become quite tall before any cane is formed, and that the leaves are at first very far ahead of the canes in their growth. While the leaves are rapidly succeeding one another and pushing up into the air, they are at the same time gradually becoming broader, the first leaves being very narrow, but the later ones soon reaching a respectable width, and this is to be accounted for by what is going on in the stem below. From the slender, pencil-like joint which starts from the bud on the set, a cane has to be built up which will support the whole aerial part of the plant, and it is obviously necessary that the stem should emerge from the ground with its full thickness and grow up thereafter pillar-like in form. As each individual joint is more or less of uniform thickness throughout its length,.a greater size of cane can only be obtained by each joint becoming thicker than its predecessor. A vertical section through the stem at the base of a young plant will thus have the form of an inverted cone made up of a series of disc-like segments, the lower ones narrow the upper ones broader. Every joint bears one leaf and, as a great number of the latter are wanted at the earliest possible moment to provide food to build up the tissues of the plant, a large number of joints are found in this basal cone. The leaves have a broad insertion on the joints, in fact, at a later period more than fully encircle it, so that as the joints gradually become thicker, the leaves belonging to them become broader. This increase in width of successive leaves is rather slow at first, but there is nothing to hinder their growth in length, and they may be 4 or 5 ft. long before the stem has reached its full thickness and emerged above the ground. Any attempts to measure the growth of the cane, depending on the height of the plants in the field, are therefore misleading, and the real difficulty of studying this growth lies in the fact that the young joints and their attached organs are, throughout their period of increase, deeply hidden away within a mass of protecting older leaves, which must be removed before they can be observed. As such removal will seriously interfere with normal growth, if it does not actually dry up the tender inner parts, the matter becomes a good deal complicated. The way in which these difficulties have been overcome, and a connected study of the growth, from the commencement, of the stem and leaves of the cane plant has been rendered possible, form the subject of the present paper.

The mature cane plant above ground consists of a series of joints, one above another, each of which bears a leaf with a bud in its axil. The leaf consists of two parts, a broad, green, flat lamina or blade, and a thicker, stiff, lower portion which fixes it to the stem, the leaf sheath. These two parts of the leaf are separated by a kind of hinge, the leaf joint, which makes it possible for the blade and sheath to be placed at an angle with one another, so that they do not lie in the same line whether straight or curved. At the point of junction of blade and sheath there is a more or less distinct coloured band which we may call the "transverse mark," and this in younger leaves serves as a useful guide as to where the blade ends and the sheath begins. These parts are shown in the accompanying drawing.

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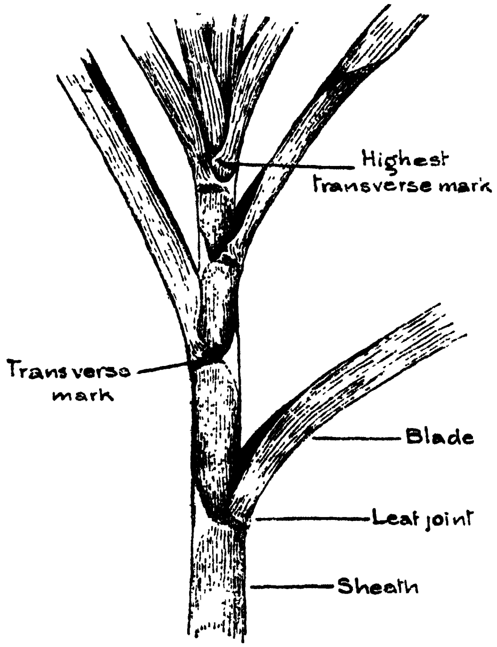
[1] The previous articles of this series appeared in our issues of Oct., Nov., Dec., 1919, Feb., and April, 1920.

We have to study the growth in length of these three parts, the joint, sheath, and blade, and we shall find that they differ a good deal in time and degree. The time-honoured rough and ready method of measuring the growth of the cane was to fix a stake firmly in the ground and tick off on it the position of the uppermost clean cane joint which might be called mature. If marks are made on the stake at intervals of, say, a month or a fortnight, the distance between two successive ones will give the growth of the cane during that period. But this method is liable to the objection that it is difficult to decide just what joint is mature, for the different varieties vary a good deal in the ease with which they throw their old leaves, and if these are gently removed the personal factor of the observer plays a rather too prominent part in the measurements to inspire confidence.



THE PARTS OF THE CANE LEAF.

In the absence of direct observation of the growing parts the first problem is to determine whether there is any definite external point on the plant which bears a fixed relation to the hidden apex of the stem. Fortunately for our study there is such a point, and by its use a good deal of information has been obtained. In 1904 KAMERLING[1] in Java pointed out that the highest, just visible transverse mark could be used as a fairly safe guide to the position of the parts within. And, as his work lies at the foundation of all subsequent studies on the growth in length of the parts of the cane, it will be necessary to consider it carefully, without going into unnecessary detail, for the paper is in Dutch and rather long and complicated. He was able to show that there is a definite sequence in the growth in length of the blade, sheath and joint. First of all the leaf shoots up, then the sheath elongates and lastly the joint belonging to them increases in length. KAMERLING further discovered that these three periods are sharply separated from one another: the sheath does not begin to grow in length until the blade has stopped: the joint again only commences to lengthen when the sheath has attained to its full size. This sequence of growth has a close connexion with the proper nourishment of the plant. The leaf is matured as early as possible, both to prevent evaporation and the wilting of its tender tissues and to give as large a surface as possible for feeding on the atmosphere. It shoots straight up into the air. When it has completed its growth, the sheath, acting as its base, with all its cells ready formed and merely needing extension, in a very short time pushes the leaf further into the air, thus separating it from its neighbours in the bunch, and also, because of the leaf joint throwing it outwards, away from the mass in the centre, so that there may be freer circulation of air around the blade. The stem when it in its turn elongates completes this important operation, the weight of the leaf causing it to fall more and more from the vertical position so as to give more room for the succeeding leaves.

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[1] KAMERLING, J. De lengtegroei van het riet. Archief voor de Java-suikerindustrie, 1904, p. 997.

The way in which KAMERLING was able to fix upon the highest transverse mark as indicating the position of the hidden stem apex was as follows. He found by measurement that the moment of its appearance to view practically coincided with the completion of the growth in length of the sheath. When the sheath had reached its full length and the transverse mark appeared, the joint to which it was attached was about one-third of an inch in length, and the joints above it right to the apex were still shorter as well as narrower. None of these joints had as yet commenced to grow in length. Any upward movement of the newly emerged transverse mark—and this took place now fairly rapidly—was therefore to be traced to the elongation of the part of the cane below the point of attachment of the sheath. We have thus, in the upmost visible transverse mark a fixed point of the nature desired. By measuring the height of this mark above the ground we can at any time calculate the length of cane which has attained its full thickness, by deducting the length of the sheath, and by a series of measurements at different periods we can form a fairly accurate estimate of the rate of growth in length of the cane.

But there is a proviso in the use of this method of KAMERLING's. It assumes that the length of successive matured sheaths is the same all up the stem. If, for instance, a short sheath were succeeded by a long one, the growth of the cane during the interval would be greater than that inferred by the observation of the marks. This point was appreciated by him and he measured the length of all the sheaths in a number of canes. The result of this showed that, during the period of active growth, when the cane had attained its full size, the sheaths rarely differed by more than a quarter of an inch in length, but that at the commencement of growth and towards the end the sheaths rapidly became shorter. The method therefore cannot be relied on in the early and late stages of the cane's growth. The importance of this proviso is illustrated by a piece of work done recently in India. TALUQDAR,[1] in 1915, studied the growth in length of a number of Indian varieties, at the Agricultural Station at Sabour in Bihar. He first of all drove strong iron stakes deep into the ground and marked them at the actual ground level, before this was obscured by subsequent tillage operations and earthing up. From these marks as fixed points measurements were taken at intervals to the uppermost transverse marks in order to judge of the rapidity of the growth of the canes in different months. But it has been shown by the writer of this article[2] that, although there is little variation in the sheath length in thick tropical canes during the period of full growth, this is by no means the case with indigenous Indian ones. Differences of over an inch between adjoining sheaths are not uncommon. Further, TALUQDAR appears to have taken no note of KAMERLING's warning as to the danger of applying the method at the commencement and end of the growing period, but began his measurement at the earliest possible moment. Fortunately for his deductions, the measurements were only taken at comparatively long intervals, so that much of the irregularity of length of leaf sheath was ruled out, and the results are of considerable value. The similarity of growth conditions in North India to those in Louisiana was clearly brought out. In both cases the growing period is extremely short, barely exceeding six months, and the growth during that period is very rapid, probably a good deal more so than in most tropical countries, where the period ranges somewhere round twelve months and in some cases considerably beyond it. It is obvious that without this rapid growth in these extra-tropical regions hardly any crop worth reaping could be grown. In both cases intense heat with great moisture presents ideal conditions for forcing the plants to their greatest activity of growth in length, and in both cases the period is terminated by a decrease in temperature and sometimes of moisture in which no further growth is possible.

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[1] TALUQDAR, J. M. Notes on the growth of the sugar cane. Bihar and Orissa Agricultural Journal, April, 1915.

[2] BARBER, C. A. Studies in Indian sugar canes, No. 5. Memoirs of the Department of Agriculture in India, Botanical Series, 1919, p. 159 and Plate I.

KAMERLING touched on many other matters connected with the growth of the joints and leaves, but there is no space to deal with these here, especially as they have been much more accurately studied recently by KUIJPER, also in Java. It may be noted, in passing, that the main pieces of work connected with the subject, with which the writer is acquainted, come from Java at comparatively long intervals. KOBUS in 1887 to 1893 studied the growth in length of the leaf, and showed that the blade attained its full growth much sooner than the sheath. Kamerling's work was published in 1904, when he laid the foundation of our knowledge of the relative growth on joint, sheath, and blade. It was not until 1915 that the next important paper, written by KUIJPER,[1] appeared. As might be expected, this paper is written on a different plane to that of the earlier observers, in that it replaces the older methods by a much more up-to-date one. After working over Kamerling's results, the writer extends his observations to a thorough investigation of the whole subject. KUIJPER was interested in a disease of the cane shoot which seemed to depend on the relative growth of the various immature organs while still hidden away in the recesses of the bunch of leaves, and he found that he required much more accurate details than could be obtained by the use of Kamerling's method. In place of measurements of the growth of comparatively fully formed organs, obtained by inference, he needed actual measurements of the very youngest organs near the vegetative apex. KAMERLING had, it is true, also attempted this, and boldly cut away the older tissues and protected the young parts exposed by tin foil, but serious injuries resulted which disturbed the normal growth, and the method was abandoned. KUIJPER applied the ingenious plan of piercing the whole apex by strong needles which would leave a series of minute holes, and by unravelling the complex of leaves and joints after an interval he was able to judge by the displacement of the holes the actual growth in length of the different organs during the time. By making a series of holes one centimetre apart he was able to build up a scheme of the internal growth of the sugar cane which approached very near completeness. A second longer paper giving further details appeared in 1918,[2] and it will be sufficient for our purposes if the mean results of Kuijper's studies are summarized here.

As a convenient convention he signifies by the figure *1* the parts connected with the uppermost visible transverse mark, namely its leaf, sheath and joint; older sheaths, namely those further down the stem, he denotes by *2*, *3*, *4*, etc., while the younger sheaths, which have not yet appeared he numbers *0*, *-1*, *-2*, etc., upwards. In his first paper he generally confirms Kamerling's results. The leaf blade is the first organ to be developed and it completes its growth before the sheath commences to elongate, this being in like manner followed by the joint to which it is attached. The blade is already completely developed in *-2*, and the sheath commences to elongate there: the sheath is complete in *1* and the elongation of the stem takes place concurrently in *1* to *4*. The growth of all these parts is at first basi-petal, afterwards intercalary. That is, the top of the organ is the first to be finished and the region of elongation passes downwards along it; the lowest part next completes its growth and some more increase then takes place in the portion intermediate between the two. This applies equally to blade, sheath and joint.

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[1] KUIJPER, J. De groei van bladschijf, bladscheede en stengel van het suikerriet. Mededeelingen van het Proefstation voor de Java-suikerindustrie, 1915, p. 211.

[2] KUIJPER, J. Voortgezette metingen omtrent des lengtegroei van het suikerriet, ibid., 1918, p. 163

In the second paper he finds that the period between the first appearance to an outside observer of two successive transverse marks varies, in the kinds of cane examined, from five to seven days. Growth in length of the cane, which is confined to joints *1* to *4*, takes about 15 days to complete in this section. The growth in length during the night is considerably greater than during the day, especially in the joints immediately below the arrow. A grand period of growth is observable, as in other plants, in the sugar cane as a whole. Although rain causes some disturbance to this curve of growth it has not the power of materially altering it. Rainfall, however, strongly influences the daily growth, either by altering the relative daily and nightly increases, or, somewhat later, by increasing the general rapidity. The influence of air moisture on growth was hardly perceptible in any case examined.

The Java work on the growth of the cane was obviously conducted under strictly local conditions, and it is desirable, now that the way has been clearly indicated, that plant physiologists in other countries should take it up. This is perhaps especially the case with India, where there are an entirely different set of canes grown, and in the Louisiana plantations where the climatic conditions are so very diverse from those in Java. By following Kuijper's method, exact data may be accumulated on the experiment stations; but by Kamerling's, it is open to any planter to conduct experiments on the different varieties grown, and on the effect of varying treatment of the fields on the growth of the canes. It is a truism that in every crop the work done in any one region must be tested in other places, if the conditions of soil and climate are different, and in no crop are the local circumstances of more importance to growth and yield than in the sugar cane.

ALIN CAILLAS[1] points out that honey contains the enzyme invertase. Its presence would explain the difference in analyses of the same sample made at intervals of some months, due to the transformation of the sucrose to invert sugar. Its presence, moreover, would enhance the alimentary value of the product, by aiding digestion.

The production of cane sugar in Louisiana for the season beginning in the fall of 1919 was 121,000 short tons as compared with 280,900 tons in 1918, 243,600 tons in 1917, and 303,900 tons in 1916. The amount of cane crushed was 1,883,000 tons, or an average of 129 lbs. of sugar per ton of cane. The average yield of cane per acre was 10·5 tons as compared with 18 tons in 1918, and the estimated area harvested for sugar manufacture was 179,900 acres, as compared with 231,200 acres in 1918.

The final results of the American 1919 beet crop, as issued by the United States Department of Agriculture, show that with sowings of 890,400 acres only 692,455 acres were harvested and from this area, which compared with 594,010 acres harvested in 1918, there was produced 648,616 tons of sugar, compared with 683,091 tons that year. The sowings in 1918 were 689,780 acres and the loss 95,690 acres or 14 per cent. This year the loss was 197,945 acres or 22 per cent. These diminished results are ascribed chiefly to the very unfavourable agricultural conditions which prevailed throughout the season.

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[1] *Comptes rendus*, 1920, 170, 589-592.

The 1919 Java Sugar Crop.

By H. C. PRINSEN GEERLIGS, Ph.D.

During the 1919 season 179 sugar factories worked in Java, the total area planted being 137,655 hectares (340,138 acres); from these there was harvested 215,092,074 piculs (13,075,138 tons) of cane which yielded 21,633,524 piculs (1,315,361 tons) of sugar.

The distribution of the planted area, the cane and sugar crops, and the output per unit of area are shown in the accompanying tables. The figures collected in these tables have been derived or calculated from Mr. Dickhoff's statistics in the *Archief voor de Suikerindustrie in Nederlandsch Indië* of the last few years.

In 1918, at the time when the land had to be prepared for the planting of the 1919 crop, a large proportion of the 1917 one was still lying in the warehouses, as a consequence of the lack of shipping tonnage. The holders, who were already encumbered with that old sugar and had likewise a full new crop, which was very promising, before them, feared they would not be able to finance all that accumulation of sugar, if matters continued in the same abnormal condition; and most of them therefore resolved to decrease their plantings slightly, while a few factories preferred not to plant at all for 1919. Thus Krebet, Kenongo, Kebonardjo, Karanganom, Gondanglipoero and Tjidahoe did not plant at all, while the cane planted in the fields of Papoh was crushed in the mill of Garoem. That is why seven factories did not grind in 1919, thereby reducing the number of active establishments from 186 in 1918 to 179 in 1919. The total area under cane decreased from 402,943 to 340,138 acres.

The weather was not favourable during the growing period of the cane for the 1919 crop. The months of October, November and December proved very dry, while at the same time irrigation water was only sparingly put at the disposal of the cane planters, since the scarcity of food-stuffs induced the Government to try

I.—CANE CROP.

Residencies and Totals.	Number of Factories in Operation.	Land under Cane.		Cane Harvested.		
		Hectares.	Acres.	Tons[1]	Tons per acre.	Kilograms per hectare.
Cheribon	12	7,934	19,604	611,171	31·26	78,241
Pekalongan	18	14,064	34,752	1,280,776	36·85	92,514
Kedoe and Banjoemas.	8	7,961	19,670	862,726	43·85	110,094
Djokdjakarta	16	10,873	26,867	1,142,421	42·50	106,700
Soerakarta	14	10,957	27,074	1,108,933	40·97	102,870
Semarang	12	8,809	21,767	845,108	38·82	97,474
Madioen	6	5,617	13,879	542,917	39·10	98,171
Kediri	20	20,775	51,334	1,843,228	35·91	90,164
Soerabaja	36	24,254	59,930	2,377,760	39·62	99,476
Pasoeroean	28	20,360	50,309	1,868,642	37·13	93,210
Besoeki	9	6,051	14,952	591,456	39·83	99,998
Total, 1919	**179**	**137,655**	**340,138**	**13,075,138**	**38·10**	**96,517**
,, *1918*	186	163,071	402,943	15,637,342	38·44	97,387
,, *1917*	185	160,439	396,440	17,079,303	43·09	108,179
,, *1916*	186	155,928	385,290	15,878,300	41·11	103,218
,, *1915*	186	151,165	373,500	14,189,000	37·99	96,385
,, *1914*	186	147,465	366,000	14,901,000	40·87	102,009
,, *1913*	190	145,321	359,200	14,951,300	41·63	104,534
,, *1912*	184	140,303	346,800	14,374,300	41·53	104,263
,, *1911*	185	135,780	335,600	14,068,900	41·94	105,307
,, *1910*	182	126,523	312,600	12,199,400	39·03	97 997

[1] Tons of 2240 lbs.

II.—SUGAR EXTRACTED.

Residencies and Averages.	Kilograms per acre.	Lbs. per acre.	On 100 Cane.	Maximum output of any single factory.	
				Kilograms per hectare.	Lbs. per acre.
Cheribon	7,937	7,079	10·02	8,572	7,646
Pekalongan	8,868	7,912	9·59	10,965	9,780
Kedoe and Banjoemas	10,204	9,101	9·27	11,636	10,379
Djokdjakarta	11,803	10,528	11·06	13,525	12,064
Soerakarta	11,380	10,115	11·06	14,639	13,057
Semarang	10,335	9,218	10·61	11,166	9,960
Madioen	10,132	9,037	10·32	11,044	9,852
Kediri	8,641	7,707	9·58	10,940	9,758
Soerabaja	10,018	8,902	10·07	12,297	10,968
Pasoeroean	9,086	8,104	9·75	12,663	11,295
Besoeki	9,817	8,756	9·32	11,723	10,456
Average, **1919**	**9,706**	**8,657**	**10·06**	**14,639**	**13,057**
,, *1918*	10,904	9,723	11·19	15,996	14,265
,, *1917*	11,382	10,117	10·50	16,415	14,696
,, *1916*	10,355	9,238	10·03	15,300	13,650
,, *1915*	8,729	7,788	9·15	12,941	11,546
,, *1914*	9,526	8,495	9·28	14,125	12,602
,, *1913*	10,087	9,110	9·65	14,708	13,122
,, *1912*	10,026	8,910	9·63	13,490	12,034
,, *1911*	10,805	9,617	10·26	15,091	13,460
,, *1910*	10,121	9,037	10·33	13,794	12,306

III.—SUGAR PRODUCTION IN TONS.[1]

Residencies and Totals.	First Sugars.	Centrifugalled After-products.	Sack Sugar.	Total Production; Centrifugalled After-products 4 : 3; Sack Sugar 2 : 1.	Solidified Molasses.
Cheribon	60,335	984	394	61,273	578
Pekalongan	121,925	1,043	60	122,737	8,081
Kedoe and Banjoemas	79,741	293	49	79,985	9,231
Djokdjakarta	125,120	1,406	281	126,214	988
Soerakarta	121,051	2,232	7	122,728	308
Semarang	87,561	2,694	43	89,554	9,868
Madioen	55,759	439	40	56,108	1,532
Kediri	175,886	937	52	176,105	25,905
Soerabaja	234,530	5,790	173	238,958	13,213
Pasoeroean	178,592	4,263	498	183,038	19,193
Besoeki	56,734	2,261	56	58,458	7,406
Total, **1919**	**1,297,320**	**22,342**	**1,653**	**1,315,158**	**96,303**
,, *1918*	1,714,833	45,292	2,700	1,750,197	18,511
,, *1917*	1,779,654	18,708	3,976	1,793,415	49,870
,, *1916*	1,579,670	27,736	4,564	1,604,154	85,749
,, *1915*	1,273,190	28,977	6,335	1,298,307	127,543
,, *1914*	1,305,246	91,544	8,514	1,382,825	94,765
,, *1913*	1,381,673	112,838	13,164	1,442,884	65,756
,, *1912*	1,338,607	50,362	11,324	1,384,242	75,510
,, *1911*	1,403,642	43,799	14,047	1,443,465	58,288
,, *1910*	1,243,103	—	30,368	1,258,287	—

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[1] Tons of 2240 lbs.

IV.—Subdivision of the Crop in Percentage according to Assortments.

Residencies and Averages.	White plantation sugar: first runnings.	White plantation sugar: second runnings.	Channel assortment refining crystals, 16/20 D.S. pol. 98.	Refining crystals, 11/13 D.S. pol. 96·5.	Second boilings.	Molasses Sugar.	Centrifugalled last product.	Sack sugar.	Total.
Cheribon	43·4	6·3	24·0	24·1	—	1·6	—	0·6	100
Pekalongan	60·2	7·0	15·2	16·8	—	0·7	—	0·1	100
Kedoe and Banjoemas	—	—	53·4	46·3	—	0·2	—	0·1	100
Djokdjakarta	76·8	1·4	10·3	10·2	—	0·8	0·3	0·2	100
Soerakarta	80·4	1·6	10·2	6·1	—	1·7	—	—	100
Semarang	47·9	2 7	21·0	25·7	—	0·5	2·2	—	100
Madioen	78·1	4·4	6·2	10·4	—	0·7	0·1	0·1	100
Kediri	55·3	0·7	16·1	27·2	—	0·4	0·2	0·1	100
Soerabaja	58·0	2·5	17·7	19·6	—	2·2	—	—	100
Pasoeroean	18 8	—	40·1	38·6	—	1·6	0·7	0·2	100
Besoeki	—	—	61·4	34·8	—	0·8	3·0	—	100
Average, **1919**	**49·7**	**2·1**	**23·1**	**23·3**	—	**1·2**	**0·5**	**0·1**	**100**
,, *1918*	45·9	3·2	27·0	21·0	0·1	2·4	0·2	0·2	100
,, *1917*	50·3	1·9	40·6	6·2	—	0·7	0·1	0·2	100
,, *1916*	48·1	2·9	37·3	9·7	—	1·4	0 2	0 3	100
,, *1915*	43·8	4·2	34·9	14·1	0·3	1·7	0·5	0·5	100
,, *1914*	40·3	4·0	32·3	15·7	0·1	5·8	1·1	0·7	100
,, *1913*	32 9	6·8	30·0	20·9	0·8	6·4	1·3	0·9	100
,, *1912*	33·6	5·6	29·9	26·2	0 1	2·4	1·4	0·8	100
,, *1911*	35·2	0·2	33·4	27·1	—	1·7	0·2	2·2	100
,, *1910*	34·9	—	30·2	31·8	—	—	—	3·1	100

and increase the production of rice, maize, tapioca and similar crops, thus necessitating a considerable supply of the available irrigation water being taken from cane cultivation, Further, influenza, which raged violently in Java, interfered largely with the field work and left many operations undone that were necessary for the thriving of the cane. Finally, the price of fertilizers had gone up tremendously, and they had become scarce too, a circumstance that prevented the planters using them as freely as might be desirable. It was a piece of luck that at the time when any importation of ammonium sulphate was quite impossible, cargoes of Chile saltpetre arrived; experiments, made on a large scale by the experiment station, showed that the nitrogen in that fertilizer is just as good for the Java cane as that in sulphate of ammonia.

The cane varieties in Java are and remain the subject of much study. New seedling canes are constantly being raised by the experiment stations and by individual planters, who select the best kinds and propagate them for use in the

V.—Percentual Composition of the Cane Plantings for the Crop of—

Variety	1913	1914	1915	1916	1917	1918	1919
B. 247	54	58	57	54	48	41	29
P.O J. 100	32	29	30	30	31	28	16
Cheribon	8	6	5	5	4	3	1
P.O.J. 213	1	1	1	1	1	1	—
E.K. 2	—	1	1	2	4	4	6
E.K. 28	—	—	—	—	2	6	23
F. 90	—	—	—	1	2	4	4
D.I. 52	—	—	—	—	1	4	13
Tjep. 24	—	—	—	—	—	2	1
S. W. 3	—	—	—	—	—	1	1
Various	5	5	6	7	7	6	6
Total	100	100	100	100	100	100	100

cane fields. We give here the statistics of the varieties used for the crops of the last seven years; these show clearly that the old Black Cheribon cane, the only one which dates from the period before the seedlings came into use, occupies but 1 per cent. of the total area, and also that old seedlings decrease in importance while new ones come to the front. Only varieties occupying 1 per cent. and more of the plantings are represented in the list.

The cane production over the whole island amounted to 38·10 tons per acre or little under the 1918 result, which was 38·44 tons. Among the residencies, Banjoemas is foremost with 43·85 tons, closely followed by Djokdjakarta and Soerakarta, respectively with 42·50 and 40·97 tons. The residencies, which as a rule are worst off in regard to irrigation water, viz., those of Cheribon, Kediri and Tegal, yield the lowest tonnages, being respectively 31·6, 35 91 and 38·85 tons per acre.

The extraction of sugar on 100 of cane is nothing to boast of, being only 10·06 per cent. against 11·19 per cent. the year before. Soerakarta and Djokdjakarta are highest, both with 11·06 per cent., while the residency with the highest cane crop is at the same time the one with the lowest sugar content in the cane and the worst yield of sugar on 100 cane, viz., 9·27 per cent. in Banjoemas and Kediri. As a consequence of the low yield of sugar per 100 cane and the modest tonnage of cane per acre, the output of sugar to the acre is not brilliant, either, having amounted to 8657 lbs. of sugar per acre, against 9723 lbs. in 1918. The residency of Djokdjakarta made the highest record, being 10,528 lbs. of sugar to the acre, and Cheribon was lowest with only 7079. The highest figure, in this respect, of any single factory during the entire grinding season is reported from the residency of Soerakarta, with 14,639 lbs. of sugar to the acre. That same factory made 15,996 lbs. last year, which shows how great the influence of unfavourable weather has been in 1919. The joint effect of the considerably reduced area and the rather low yield of sugar per acre finds its expression in the total amount of sugar produced, which is calculated at 1,315,158 long tons. This production is much smaller than that of the immediately foregoing years, in fact one has to go back as far as 1915 to find so low a figure for the Java crop.

In the year under review more than half the sugar produced consists of white plantation sugar, fit for immediate use. The quantities of grey and of brown refining crystals are about the same, amounting respectively to 23·1 and 23·3 per cent. of the total crop. The black after-products do not exceed 1·8 per cent. of the total, and they diminish in importance every year.

Besides the sugar already mentioned, Java produced 96,517 tons of solidified molasses. In recent years the exportation of this product suffered greatly from the lack of steamer capacity to British India, but as soon as this was rectified the production of solidified molasses rose again to a very satisfactory figure.

The following table has been compiled from the data issued annually by the Chemical Department of the Java Sugar Experiment Station. These figures cover a period of 10 years and they may be usefully supplemented by the following general remarks on the comparative results.

The *sucrose content of the cane* was much lower in 1919 than in 1918, but one must not forget that the last mentioned year was uncommonly high. This year it is 12·38 per cent. or a good average, as the general average of the last ten years may be calculated at 12·49 per cent. The highest sucrose content over the whole season is reported from Pohdjedjer with 15·11 per cent., the lowest is from Soekodono with 9·93.

The *fibre content of the cane* is much the same as last year. In the specification we find the highest fibre content from de Maas with 16·16 per cent., the lowest from Sempalwadak with 10·73.

In combination with the lower sucrose content of the cane, the *sucrose content of the bagasse* is much lower than in 1918. It is now given as 4·01 per cent. for the whole island with a maximum for Sedajoe of 7·40 per cent. and a minimum for Ngadiredjo of 2·39. These two factories were highest and lowest too in 1918.

The *moisture content of the bagasse* is rather high, especially if we take into account the rather low sucrose content of the cane, which does not require a large amount of maceration water. We find an average of 47·01 per cent. with a maximum for Djatiroto of 52·13 per cent. and a minimum for Tjepiring of 41·88.

The *sugar extraction in juice on 100 parts of sucrose in cane* is also not particularly good, being 92 per cent.; this gives rise to some disappointment, because the arduous work done by the Technical Department of the Java Sugar Experiment Station in connexion with the improvement of the milling of plants had led us to believe that especially in a year when small amounts of cane had to be worked up, a considerable rise of that value might be witnessed. The figure has been decreasing since 1917 and is now not much higher than in 1910 when it amounted to 91·2 per cent.

VI.—FACTORY RESULTS DURING THE LAST DECADE.

	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919
CANE—										
Sucrose	12·54	12·71	12·35	12·54	11·91	11·63	12·42	12·82	13·63	12·38
Fibre	12·27	12·52	12·17	12·40	12·61	13·26	13·14	13·02	12·99	13·01
BAGASSE—										
Sucrose	4·32	4·60	4·47	4.45	4·21	4·11	4·00	4·10	4·34	4·01
Moisture	46·72	46·75	46·52	46·52	46·27	46·64	46·97	46·82	47·22	41·01
Sugar extraction by mills	91·2	90·6	90·8	90·8	90·4	91·9	91·1	92·3	92·1	92·0
Sucrose in filter press cakes	6·13	7·30	6·96	7·00	6·72	7·97	4·51	4·15	4·36	3·70
Sucrose in juice on 100 cane	11·43	11·52	11·21	11·38	10·77	10·69	11·32	11·83	12·55	11·39
Purity of raw juice	84·67	84·57	81·47	80·95	80·39	82·00	84·41	85·80	86·50	83·7
Purity of final molasses	33·42	33·54	33·00	32·92	32·70	32·45	32·4	32·6	33·1	32·1
Calculated available sugar	10·93	11·00	10·44	10·33	9·94	10·90	10·80	11·40	12·17	10·60
Sugar extracted on 100 cane	10·76	10·80	10·21	10·00	9·76	9·65	10·42	11·00	11·68	10·44
SUCROSE TURNED OUT ON 100—										
Cane	10·23	10·38	9·80	9·75	9·33	9·18	10·60	10·48	11·27	10·12
Sucrose in cane	81·82	81·67	79·35	77·75	78·34	79·20	81·00	81·75	82·61	81·66
Sucrose in juice	89·76	90·10	87·42	85·77	86·63	86·40	88·90	88·58	89·80	88·85
SUCROSE LOST ON 100—										
Cane	2·28	2·33	2·55	2·79	2·58	2·45	2·36	2·34	2·36	2·26
Sucrose in cane	18·18	18·33	20·65	22·25	21·66	20·87	19·00	18·25	17·39	18·34
Sucrose in juice	10·24	9·90	12·58	14·23	13·37	13·60	11·10	11·42	10·20	11·15
IN BAGASSE ON 100—										
Cane	1·11	1·19	1·14	1·16	1·14	0·94	1·10	0·99	1·08	0·99
Sucrose in cane	8.85	9·36	9·23	9·25	9·57	8·08	8·86	7·72	7·92	7·99
IN FILTER CAKE ON 100—										
Cane	0·10	0·10	0·10	0·11	0·13	0·12	0·10	0·09	0·10	0·06
Sucrose in cane	0·80	0·79	0·82	0·86	1·09	1·03	0·80	0·74	0·73	0·49
Sucrose in juice	0·87	0·87	0·89	0·98	1·21	1·12	0·80	0·80	0·80	0·53
IN MOLASSES ON 100—										
Cane	0·98	0·96	1·16	1·22	1·01	1·09	0·85	0·91	0·94	0·90
Sucrose in cane	7·81	7·55	9·39	9·73	8·48	9·38	6·84	7·11	6·95	7·27
Sucrose in juice	8·57	8·33	10·35	10·74	9·35	10·20	7·59	7·70	7·50	7·90
UNACCOUNTED FOR ON 100—										
Cane	0·09	0·08	0·15	0·30	0·30	0·30	0·36	0·35	0·24	0·31
Sucrose in cane	0·72	0·63	1·21	2·41	2·52	2·38	2·50	2·68	1·17	2·59
Sucrose in juice	1·00	0·70	1·32	2·51	2·81	2·29	2·66	2·92	2·54	2·72

The *loss of sucrose in bagasse on 100 parts of cane* amounted on an average to 0·99 per cent. and *100 parts of sucrose in cane* to 7·99, both figures that do not exceed last year's results.

The *sucrose content of the filter-press cake*, on the other hand, is decreasing every year and now is no more than half that of 1910. The weight of the filter-mud is also not great; the loss of sugar in filter-press mud on 100 parts of cane as a consequence has dropped to only 0·06 per cent., equivalent to 0·49 on 100 parts of sucrose in cane and to 0·53 on 100 sucrose in juice. The average sucrose content of the mud obtained in factories, clarifying by the ordinary defecation process, amounts to 5·25 per cent., that of those using sulphitation to 5·38 per cent. and that of those using carbonatation to only 0·79. The maximum of both first-named categories lies at 10·86 in Gempol and the minimum at 1·69 in Poerworedjo, while the maximum sucrose content of the press cakes of the factory having the carbonatation process is 1·51 at Boedoeran and the minimum 0·28 at Barongan. As a consequence of the rather mediocre sucrose content and the equally ordinary mill work, the figure for *sucrose in juice on 100 parts of cane* is neither uncommonly good nor very bad, and amounts to 11·39 per cent. with a maximum of 14·70 at Pohdjedjer and a minimum of 8·58 at Soekoedono.

As a rule a high figure for sugar in cane is accompanied by a high value for *quotient of purity in the juice* and *vice versa.* It should therefore be no matter for surprise that in 1919 the quotient of purity of the raw juice was not higher than 83·7. Here two the highest sugar content of Pohdjedjer is accompanied by the highest quotient, viz.: 89·4, while the lowest sugar content, that of Soekoedono, comes together with the lowest quotient on record, namely 77·1.

The *quotient of purity of the final molasses* is lower than last year and is given as 32·1, which is in accordance with the lower value for the purity of the initial juice. The comparative figures for the five highest and the five lowest results follow here, from which table we see again that there is no fixed proportion between the purity of raw juice and of the final molasses. The method of clarification does not appear either to have had a marked influence on the rate of desaccharification from juice to molasses.

FACTORY.	METHOD OF CLARIFICATION.	PURITY OF JUICE.	PURITY OF MOLASSES.
Kawarassan	Defecation	81·1	28·5
Karang Soewoeng	Defecation	82·4	29·1
Kentjong	Sulphitation	80·5	29·3
Redjosari	Sulphitation	83·3	29·4
Gempol	Defecation	88·4	35·3
Kremboong	Sulphitation	85·6	35·5
Wonosari	Sulphitation	82·2	35·8
Wonopringgo	Carbonatation	82·2	36·1
Pradjekan	Defecation	80·3	36·4

The *loss of sucrose in molasses on 100 parts of cane* was 0·90; on 100 parts of sucrose in cane 7·27 and on 100 parts of sucrose in juice 7·90 per cent.

The *calculated available sugar*, expressed in refining crystals of 96·5 polarization, amounted to 10·44 and that of the sugar actually turned out and calculated on that same basis to 10·12 on 100 cane, thus showing a loss "unaccounted for" of 0·32 per cent. The figure for unaccountable loss in the table, calculated by deducting the accountable losses from the total ones, yields the figure of 0·31 or one fairly identical with the first-named. This coincidence of the two values calculated in two entirely different ways, gives us much confidence in the skill and accuracy with which chemical control is conducted in Java sugar factories.

The proportion of sugar really obtained in 100 parts of the calculated available amount has been on an average 97·4 per cent., which figure, subdivided for the different methods of clarification, is 97·6 for the defecation process, 97·1 for the sulphitation, and 97·4 for the carbonatation, thus showing again that the different methods do not exert a marked influence on the yield of sugar from 100 parts of sucrose in juice.

The highest percentage of one single factory was 100·9 on 100 calculated at Soemberkareng, the lowest 90·6 at Wonopringgo, which factories had a purity of the final molasses of, respectively, 31·3 and 36·1, whereas the calculation had been based on a purity of 33½. On 100 parts of sucrose in juice 88·85 were obtained in product, a very satisfactory figure if one bears in mind that the initial purity of the raw juice was only 83·7 and that half the crop had been turned out in the shape of white sugar and one-fourth in that of very high-grade refining crystals, while the percentage of after-products was very small.

When in the month of April, 1919, the first sugars of the crop of that year reached the ports, the last lots of the previous crop had just been cleared and, against all earlier expectations, the factories could enter into the new season clear of old remnants. The late rains and the poor sugar content of the cane induced many manufacturers to retard the grinding season, thus causing the arrivals in April and May to fall below those of other years. In June, however, sugars arrived in great quantities at the ports and in November every producer had crushed all his cane and delivered all his sugar.

The sales in 1919 went much quicker and better than those of the two foregoing ones. The Associated Java Sugar Producers, who sell the product of 157 factories, equivalent to about 90 per cent. of the total crop, and whose quotations are closely followed by the holders of the other 10 per cent., started with prices of 14 guilders per picul for white plantation sugars, 13 guilders for grey refining crystals and 12·50 for the browns, which, at gold parity, is equivalent to 19s. 2d., 17s. 10d. and 17s. 2d. respectively per cwt. Once it became known that the scarcity of sugar was increasing, the Association was able to raise the price gradually, and as early as April, 1919, it had been raised to 20 guilders per picul for whites; later on small parcels were sold for 25 guilders, and, finally, a small quantity of browns for 34 guilders.

According to statistics published in the *Archief voor de Java Suikerindustrie*, the sales of sugar from the 1919 crop down to September have been as follows in piculs of 135 pounds and guilders of 1s. 8d.

GUILDERS PER PICUL.	WHITE PLANTATION. FIRST.	WHITE PLANTATION. SECOND.	GREY REFINING. CRYSTALS.	BROWN REFINING CRYSTALS.	MOLASSES. SUGAR	TOTAL.
12-13	—	—	590,880	2,371,680	—	2,962,560
13–14	3,261,770	—	205,000	191,170	—	4,017,940
14–15	1,713,900	54,410	1,738,220	—	—	3,506,530
15–16	1,117,355	—	184,140	13,500	—	1,314,995
16–17	398,696	11,980	225,000	10,000	—	645,676
17–18	386,680	1,200	25,000	—	—	412,880
18–19	300,000	—	512,640	—	—	1,656,730
19–20	517,940	35,900	30,000	844,090	—	582,940
20–21	872,350	85,000	30,000	—	—	987,530
21–22	—	10,000	—	—	—	10,000
22–23	50,000	30,000	—	247,050	180,000	507,050
23–24	—	—	100,000	—	—	100,000
24–25	715,000	—	50,000	—	—	765,000
25-26	—	175,000	98,820	—	—	273,820
34–35	—	—	244,410	519,100	—	763,510
35–36	—	—	—	625,860	—	625,860
	9,693,691	402,590	4,034,110	4,822,450	180,000	19,132,481

The total Java crop of 1919 amounted in all to 21,633,524 piculs, so that the sales mentioned here cover 90 per cent. of the total production. We calculate from these the average price for the assortments and the monetary value of that part of the crop in guilders.

ASSORTMENT.	GUILDERS PER PICUL.	MONETARY VALUE IN GUILDERS.
White first sugar	15·77	152,896,000
White second sugar	21·86	8,804,000
Grey refining crystals	17·27	69,683,000
Brown refining sugar	19·44	93,958,000
Molasses sugar	22·50	2,250,000
Total	17·12	327,591,000

We see from this table that the white first sugar, although the most superior product, has fetched the lowest average price, while, on the other hand, the after-product molasses-sugar fetched the highest figure. The reason for this strange fact is not to be sought for in a wrong appreciation of the various assortments, but in the circumstance that the first sales at the lowest prices have been in whites, while later on, when prices have gone up generally, the brown and black sugars were sold. After this table had been calculated, it appeared that, owing to a better result than had been anticipated, some more sugar could be sold, and it changed hands at the then ruling high prices.

The final result is that the 21,633,524 piculs of sugar from the 1919 crop have been sold at an average of 18·43 guilders per picul, equivalent to 25s. 3d. per cwt. This is the average price for all assortments, packed in gunny bags and delivered at the buyers' door at the ports. The total monetary value of that crop paid to the manufacturers may be calculated at about 400 million guilders or 33 million pounds sterling.

On January 1st, 1919, a stock of about one million tons of sugar was still lying in the Java warehouses, but transportation to the countries of destination went on so smoothly, that notwithstanding this reserve and the returns of the 1919 crop, the stocks at the end of the year were only 250,000 tons, and these have since mostly left Java. The 1920 crop starts therefore without any appreciable old stocks.

We give here the exports of Java sugar for the last five years, from 1st of April to 31st of March. They show us how the scarcity of sugar spreads all over the world and how constantly new customers come and endeavour to get a share of the Java production.

To sum up the Java sugar crop of 1919 in one sentence, we can say that the crop planted in 1918 under the most gloomy forecasts has yielded an average return of a good and sound quality of sugar, which has been sold at very satisfactory prices and has been shipped to its ultimate destination without a hitch.

VII.—SUGAR EXPORTS 1ST APRIL—31ST MARCH. LONG TONS.

DESTINATION	1915-16	1916-17	1917-18	1918-19	1919-20[1]
Netherlands	412	31,809	—	—	21,283
United Kingdom	234,940	548,980	317,955	142,547	119,528
France	72,949	69,592	34,468	55,536	41,636
Switzerland	—	—	—	6,528	—
Russia	—	—	—	2,958	1,414
Denmark	—	—	—	—	2,370
Sweden	—	—	—	—	14,522
Norway	—	11,855	19,780	44,272	50,152
Italy	—	20,724	—	5,495	45,956
Spain	—	—	—	—	6,909
Greece	—	—	11,793	5,162	8,239
Rumania	—	—	—	—	3,921
Turkey	—	—	—	—	23,321
Egypt	—	—	—	2,844	—
Argentina	—	—	—	5,200	—
Suez	19,895	11,918	18,231	28,870	10,652
Port Said, f.o.	40,321	25,117	12,205	19,438	53,091
United States	—	—	—	7,423	—
Vancouver	—	6,007	3,514	17,656	2,953
Singapore	52,949	60,212	157,736	163,230	61,756
China	18,458	6,987	2,314	31,961	3,525
Hong Kong	181,672	136,829	163,654	308,792	177,156
Japan	48,244	49,369	90,802	439,396	257,305
British India	451,703	407,018	336,736	343,480	320,817
Australia	45,662	25,292	—	30,000	71,963
Siam	9,401	16,138	21,397	3,612	152
Other countries	—	—	141	100	3,428
Total	1,176,487	1,427,848	1,190,726	1,664,801	1,308,049

[1] 11 months.

The Uba Cane.

Some further Data as to its Origin.

An anonymous writer in the *South African Sugar Journal* attempts to throw some light on the origin of the Uba cane in Natal and to suggest the derivation of that name. According to him when 30 years ago a blight disease threatened the extinction of the sugar industry in Natal, one of the estates owned by Mr. DE PASS got into communication with sugar estates all over the world, and obtained varieties from Egypt, Louisiana, Mauritius, the West Indies, and tops from India. One box of tops was misplaced for a while and when found the cuttings were almost dead; only two of them were successfully planted and propagated, but from these a new variety was clearly established. Whereupon it became necessary to find some word by which to designate it. An attempt to trace the label only resulted in the finding of three letters which were badly written and which were deciphered as "Uba." As however there was no doubt that these tops had come from Poona, India, it was assumed that the last three letters of "Poona" read like "Uba." Hence, so the story goes, the adoption of this appellation for the standard cane of Natal and Zululand. Admittedly, this story is a variation, if not a confirmation, of the one given three years ago in some interesting conjectures which the Superintendent of the Jamaica Botanical Gardens, Mr. W. HARRIS, published in his annual report for 1916, on the origin of the nomenclature of this cane. In his version, derived from various sources, including that of the *Kew Bulletin*, the name Uba was also described as being the only decipherable letters on a damaged label, but it was hazarded that "Uba" was part of the name "Bo*uba*ya" (a Madagascar cane) which was supposed to have reached Natal via India, whence it was brought by the Acting Governor, Sir CHARLES MITCHELL, in 1885.

On the other hand, Mr. ALFRED J. WATTS, of Pernambuco, Brazil, sends us the following interesting communication as to the existence of a "Ubá" cane in Brazil quite fifty years ago:—

When first I came to Pernambuco in the year 1884 (he writes) to study the "gumming" disease on behalf of the first English company to start Centrals here, I found already under field cultivation considerable areas of a number of varieties brought in the year 1878, if I recollect rightly, from the Botanical Gardens in Rio de Janeiro, all of which were imported originally from Mauritius, and, as frequently happens, some of the labels had got loose and were wrongly re-apportioned. In the case of two at least, one a heavy claret-coloured cane with a darker stripe when green, turning to a dull terra-cotta when ripe, and the other a very green cane turning to yellow when ripe and of a less vigorous growth, they are known here as the Lousier (the red one) and Port Mackay (the green one), whereas I have it on the authority of an ex-Mauritian, who spent some two years here 20 years ago, that in Mauritius the names are reversed. The same accident may have happened in other cases.

Among them, however, was a variety named "Kavangire," a heavy, long-jointed, brick-red coloured cane with a hard rind and not very pure juice at that time. I have since met it much improved as to vigour and richness, perhaps owing to better conditions of cultivation, but it has somehow not taken on, though it still exists on a few estates.

The "Ubá" (we put the accent on the final vowel here; I cannot say on what authority) is here, however, a totally different kind of cane. It was then, and still is, grown on the estate of the late Dr. PAULO SALGADE, for many years

President of the "Sociodade Auxiliadora d'Agricultura de Pernambuco," and there only, and only as a hedge to screen more succulent varieties from the depredations of passers-by. Its reception by the management of the neighbouring Central was always a bone of contention between the planter and the factory managers, who objected to the sacrifice to their yields by grinding "walking sticks," the average diameter not reaching an inch and being very hard at that. The juice was pure, what little there was of it. In after years, when lessee of the factory I had it all in at once at the end of crop and set the mill to suit it. It still grows in the same rows after some 40 years, or more, and apparently ratoons indefinitely. Rats and foxes pass it by. Possibly with good cultivation it would improve, and I once induced a friend to try and cross it with "Bourbon" cane. He succeeded after one or two trials, but a wandering cow unfortunately made a premature examination and left nothing for further experimentation. I have met specimens up to 1½ inch in diameter, but the general appearance is more like a reed than a sugar cane and the leaf sheaths are most difficult to separate from the stem and have mostly to be ground with them.

I have two letters from Dr. SALGADE in which he says: "In 1880 an African who worked in my orchard, having gone into the neighbourhood of the town of Cabo (30 kilometers from the capital town, Recife), brought home very contentedly two canes, "Ubá" canes, saying that they were canes of his native land, Angola. I planted them carefully and developed them and wrote a paper about them, comparing their results in my factory, a small factory with a copper wall, Wetzel pans and centrifugals, with those from "cayanna" (Bourbon) cane, in that year very sick with the gumming disease. This was published in the first issue of the Agricultural Society Bulletin, in 1882. In 1901, when in Rio, I learnt in conversation with members of the Soc. Nacional d'Agricultura that it still grew in Rio, where it is used as a forage plant, and last year, 1917, I was shown Uba cane, among the forage plants exactly similar to our own."

In a second letter he wrote to me he further stated that: "After my African gardener planted the canes I acquired the 'Estudes Agricolas' of Dr. JOÃO JOSÉ CARNEIRO DA SILVA (Barâc de Monte Cedro), agriculturist in En Campes, State of Rio, and co-proprietor of the Central Factory 'Quissa man.' In the first volume, of 1872, p. 8, I read: There grows among us a variety of cane, which perhaps improved by careful cultivation may become the selected cane of these regions. I refer to the Ubá, which, according to some, is indigenous in this place. We cannot affirm nor contest this belief with respect to the Ubá cane. What appears to be without doubt is that it is of all the varieties that which prospers with greatest vigour from the point of view of its foliage, its height and uprightness, and also is the most resistant to bad weather, and once planted anywhere is difficult to eradicate and appears to spring up spontaneously, in places where nobody, according to tradition, brought it. If not indigenous it unites, at least, characteristics which cause it to find in these places, more than any other varieties, the most favourable conditions to life. It is, however, poor in saccharine matter, and some say that its juice is very salty (*Auxiliadora da Industria Nacional* of 1867, p. 405).

"Reading these descriptions," continues Dr. SALGADE, "I was convinced that the Angola cane is identical with the Ubá, which conviction I saw confirmed last year (1917) when in Rio at the Cattle Show, where I saw among the graminaceous fodders bundles of Ubá canes exactly like ours.

"Again in the *Jornal de Agricultor* of 1879 (Vol. I, July–December, p. 289) can be read a description amid several others of a white China cane; synonyms

French, Canne de Chine, Chinese, mia-lacu; characters, upright stalk, but very thin, white or straw colour, very hard rind, very hardy, perfectly resistant to drought and ants. The article is not signed."

Personally, and reviewing the above notes, [concludes Mr. Watts] I do not believe that it is of Brazilian origin, and indeed I have never seen it suggested that the sugar cane is native to Brazil, except in one old book, the name of which I cannot recall, published in England in the middle of last century, whose author states that the Jesuit priests established on the Rio de Janeiro in the early colonial days cultivated sugar canes before canes were imported from Europe. Neither do I think that the name is derived from "Viba." It would be of interest to know whence Dr. Cross met with his "Kavangire" and to learn from Mr. Noël Deerr where he came across "Ubá" from Brazil. Possibly from Rio.

The Australian Sugar Commission's Report.

Some further particulars of the Report of the Australian Royal Commission on Sugar which was issued last February, have come to hand, and we give here-some data of the industry which it has published, or which arise therefrom.

The object of the Commission was to report on the sugar industry of Australia, particularly in regard to its national value, production, Government control, protection, beet sugar production, and Empire Preference. In addition the cost of production and manufacture, and the utilization of the by-products of the industry were also considered.

The introduction to the Report states that the sugar lands of Australia constitute a North to South Coastal Strip of a thousand miles, from 16° South Lat. to 30° South Lat,, and not more than 30 miles in width; yet the districts where sugar cane is grown are very scattered, and if all the lands under sugar in Australia were concentrated in one area they would only occupy a space of about 17 miles square (289 sq. miles). The total area under cane in Australia according to the latest figures for 1918-19 season was 171,100 acres, of which 10,566 acres were in New South Wales and 160,534 acres in Queensland. The average for five years ending 1918-19 was 174,535 acres for the two states combined. In New South Wales and Queensland south of Mackay there is a gradual displacement of sugar cultivation by other forms of agriculture, chiefly dairying.

Capital invested in the Industry.—The value of cane lands cleared and ready for cultivation is put down at £31 15s. per acre, which is pretty close to the price asked for farms, and applying that value to the total acreage one gets a capital value of £5,541,486. Capital invested in raw sugar mills is estimated at £5,000,000 after making allowance for depreciation. The two items above include both New South Wales and Queensland.

The number of persons employed in cultivation apart from mill workers in both states is as follows:

Cane-growers, 4690, Field Hands, 3198, Cane-cutters, 6502, Carters, &c., 1066, a total of about 15,400 persons; perhaps half of this number are only employed during five or six months of the year. In raw sugar mills and refineries the number is set down at 6600, of which approximately 5600 are employed in raw sugar mills. A total of 22,000 persons.

The Australian Sugar Commission's Report.

The wages paid under the last award dated 27th June, 1919, were fixed as follows:—

	No 1 District. NORTH.	No. 2 District. CENTRAL.	No. 3 District. SOUTHERN.
	s. D.	s. D.	s. D.
Field Workers under 18 years (youths) ..	1 1 per hr.	1 0 per hr.	0 11 per hr.
,, ,, 16 ,, ,, ..	0 11 ,,	0 9¾ ,,	0 9¼ ,,
,, over 18 ,, ...	1 8½ ,,	1 7 ,,	1 6 ,,
Cane-cutters (day labour)	2 2 ,,	2 0 ,,	1 11¼ ,,
Field Workers engaged by the week of	£ s. d.	£ s. d.	£ s. d.
48 hrs. (over 18 years of age)	3 18 0	3 12 0	3 8 0

On award rates for contract cane-cutting 28s. per day would be earned by a worker cutting 4 tons of cane per day.[1]

All the above figures in regard to wages will now be advanced about 30 per cent. in consequence of the higher cost of living and increase in price paid for raws from £21 to £30 6s. 8d. per ton.

Non-British labour.—The Commission discredited the suggestion that coloured aliens are increasing. Strong representations were made by a representative of the Australian Workers' Union as to the extent to which foreigners were taking up cane growing, and obtaining a substantial footing. The General Manager of the Colonial Sugar Refining Company said many farms in the Herbert River district, North Queensland, had changed hands, the purchasers being mostly Italians, who do not buy as a permanency to make a home, but remain a few years and then frequently go out of the country altogether. Other witnesses stated that the Italians in the sugar industry are industrious and law-abiding citizens.

Attention was paid to the question of tropical diseases, and the report shows that considerable work is being done in the eradication of these, and if supported by the general community there appears to be every hope of success.

In regard to the cost of cultivation and production of sugar cane, the Commission found it was not practicable, owing to the unsatisfactory nature of the information supplied to them, to determine these costs.[2]

The report states that the weighted average price actually paid by the mills per ton of cane for the years 1917 and 1918, covering a total of 4,659,165 tons, was £1 12s. 6½d. per ton, and of this it is considered, after deduction for burnt cane, the farmer received an average of about £1 12s. 0d. per ton.

Cultivation.—It was generally admitted in evidence that there is a great deal more to be desired in respect to efficiency in cultivation. The average production of cane and sugar per acre during recent years has been:—

	Average over 10 years, 1909-10—1918-19	Average over 5 years, 1914-15—1918-19
Cane per acre harvested	18·03 tons	18·58 tons
Sugar per acre harvested	2·08 tons	2·14 tons

It is pointed out that a comparison with other countries may be misleading owing to the different methods of cultivation, variations of climate, etc., and the evidence generally points to the fact that the average production in Australia, though slowly improving, is not satisfactory: for one thing, very little manure is used. Yet during 1918-19 the large amount of 196,954 cwts. of sulphate of ammonia was exported from Australia, 94,540 cwts. of that amount being shipped to Java, the declared export value being £35 15s. per ton at that time (though it has increased since then). Very little of this fertilizer is used in Australia compared with other countries.

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[1] No reference to the wages paid in the mills appears in the Report but they may be taken on the average as 14s. 6d. per day of 8 hrs.

[2] An Australian correspondent, who has had considerable experience in this matter, makes an estimate of about 28s. per ton of cane, which is very close to the mark for the years 1917-18.

Increasing the area under cultivation.—The following figures illustrate the annual yields:—

PRODUCTION OF RAW SUGAR.

SEASON.	TONS.	SEASON.	TONS.
1912-13 ..	129,877	1916-17 ...	193,037
1913-14 ..	265,029	1917-18 ..	327,689
1914-15 ..	245,876	1918-19 ..	202,112
1915-16 ..	159,640	1919-20 ..	166,000

The average area harvested, the tons of cane and sugar per acre during the above period were:—

Year.	Cane crushed. Acres.	Cane per acre. Tons.	Sugar per acre. Tons
1912-13 ..	84,279 ..	13,468 ..	1·54
1913-14 ..	109,001 ..	20,839 ..	2·43
1914-15 ..	114,025 ..	18,455 ..	2·155
1915-16 ..	100,489 ..	13,038 ..	1·59
1916-17 ..	81,137 ..	21,236 ..	2·38
1917-18 ..	114,295 ..	25,191 ..	2·865
1918-19 ..	117,139 ..	15,196 ..	1·725

The 1917-18 season was a phenomenal one, such as only occurs at very rare intervals. Excluding that season, the average production of the other six years shown was nearly 200,000 tons while the average consumption was 276,308 tons of sugar.

Mr. H. EASTERBY, the General Superintendent of Sugar Experiment Stations, estimates 500,000 acres as the maximum area on which cane could be grown in in Queensland. Of that area about 170,000 acres are now under cane, which leaves 330,000 still uncultivated. 120,000 acres might be classified as good cane land, about 100,000 as medium, and balance as inferior. So there is far more room for extension of the industry than is likely to be necessary for many years to come.

In New South Wales the present production is about 20,000 tons of sugar per annum and is very likely to decrease rather than to increase owing to the displacement of cane growing by dairying, and fruit growing, etc.

The British West Indian Sugar Crop.

The following table published by the Canadian Trade Commissioner gives the quantity of sugar exported from the British West Indies last year, and an estimate of the crop for the present year, which includes syrup equated to sugar:—

	EXPORTS, 1919. TONS.	ESTIMATE, 1920. TONS.
Barbados	75,271	50,000
St. Kitts	10,901	15,000
Antigua..	12,841	16,667
St. Vincent	570	1,136
Trinidad	37,805	40,000
Jamaica	43,000	48,000
British Guiana	83,140	96,000
St. Lucia..	3,661	4,400
Montserrat	58	115
Total	267,247	271,318

First Meeting of the Sugar Section of the American Chemical Society.

Testing Saccharimeters by the Telescopic Tube. Use of different Types of Saccharimeters. Development of the Polarimeter. Hess-Ives' Tint-photometer. Determination of Moisture in Beet Products. Juice Clarification, using Kieselguhr and Decolorizing Carbon. Boneblack (Animal Charcoal) and Decolorizing Carbons.

It was recently announced that instead of the formation of the proposed Society of American Sugar Chemists and Technologists it had been decided to inaugurate the organization as a section of the American Chemical Society, a body having more than 13,500 members. This has now been done, and the first meeting of the sugar section was held at St. Louis, on April 15th last, there being a good attendance of chemists and technologists representing every part of the United States, who displayed keen interest in the formation of the new association. Dr. C. A. Browne was in the chair, and Mr. F. J. Bates acted as secretary.

A number of interesting papers were read, and short abstracts of those available are here given. It is hoped later to give a more detailed account of the more valuable of these contributions.

Testing saccharimeters by means of the telescopic tube.—C. A. Browne. It was pointed out that by means of this apparatus the length of the column of sugar solution may be shortened or lengthened at will and accurately measured. It is used for (1) determining the accuracy of the saccharimeter scale; (2) for comparing scales; (3) for determining the sensibility of saccharimeters; (4) for testing ability on the part of the operator to polarize accurately; and (5) for ascertaining the influence of the "personal equation." A long series of tests covering several years shows that certain observers always read high, while others as persistently read low, so as to cause a difference of ± 0·04° on good instruments. Further, these variations are reversed according to the arrangement of the half prism of the Lippich analyser. The maximum scale error on good instruments was found not to exceed ± 0·04°V.; while the probable error of a single reading on a German instrument was ± 0·05°, and on a Bohemian ± 0·03°. Disputes regarding the value of normal weights no doubt result partly from personal equation.

Observations on the use of different types of saccharimeters.—C. A. Browne. Observations on the good and bad features noted in the practical use of instruments of American, British, French, German, and Bohemian manufacture were made, especially in regard to the open and closed construction types, the forms of polarizers, the saccharimeter scales, methods of illumination, and other details. As the result of his inspection, the author believes the outlook for the manufacture of accurate saccharimeters in countries outside Central Europe is most encouraging. He advocated the use of the more openly constructed type of instrument, and uniformity of dimensions between instruments of different makers. Polarizers of the Lippich type are more sensitive than those of the Jellet-Cornu, but less durable except under the best care. While the Laurent polarizer is of relatively simple construction, its dependence upon monochromatic light limits its usefulness. In half-shadow instruments it is advisable to have the half-shadow angle 7° to get sufficient illumination, for while 5° gives greater sensitiveness in light-coloured solutions it is unsatisfactory for dark-coloured liquids. Stress was laid upon the need of great optical purity in quartz and calcspar. Ground glass scales are the best, and those with slightly over-lapping vernier can be read with great accuracy.

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[1] *I.S.J.*, 1919, 107, 461.

Development of the polarimeter.—Noël Deerr. [This brief account is given on page 333 of this issue.]

Hess-Ives tint photometer and its use with raw sugars.—G. P. Meade and J. B. Harris. The scale readings of the Hess-Ives tint-photometer are meaningless in themselves as they do not express directly the relative amounts of colour. It was found that the scale readings for solutions containing 1, 2, 3, 4, etc., units of material run in powers of the reading for one unit, considering the scale readings as decimal fractions. This is due to the mechanical make-up of the instrument, and is true no matter which colour screen or what class of material is used. Expressed algebraically, this relationship between the scale readings and the amount of colour becomes $y = k^x$, where y is any scale reading, k is the reading for one unit of material, and x is the number of units of material required to give the scale reading y. By means of this equation solved for x, the colour of two materials may be compared, given scale readings for equal quantities; or all scale readings may be compared to a standard. To avoid the repeated calculation, a table has been calculated which gives the units of colour corresponding to each scale reading from *100* to *1*. A convenient method for determining the colour of raw sugars, using the table, was given together with results for various sugars.

Determination of moisture in beet sugar factory products.—V. L. Aitken. Attention was called to the lack of uniformity in certain procedures. Among the points that have been investigated by the author are: Variation of the size of the dividing material, the quantity of sand and of substance under examination being constant, and *vice versa;* optimum temperature of desiccation; the effect of a short preliminary drying followed by a second mixing and complete drying; and desiccation at 105° C. compared with that *in vacuo* at a lower temperature. As the result of this work, it was concluded that the most trustworthy results are obtained by operating as follows: 25- 30 grms. of sand (which has previously been passed through a sieve having ½ mm. holes, digested with hot hydrochloric acid, washed, and ignited) are placed in an aluminium dish 50 mm. in diameter and 30 mm. high (provided with a close-fitting cover), and dried previous to making the determination. A quantity of the material under examination containing not more than 1 grm. of dry substance is weighed into the dish, and 1 c.c. of water added. After placing the dish on the drying oven till it is warm, the contents are mixed till perfectly homogeneous. Desiccation is effected at 105° C. for six hours, and at the end of this time dish and contents are weighed at hourly intervals till the loss is less than 0·10 per cent. All weighings are made as soon as the temperature of the desiccator is within 2° C. of that of the balance.

Clarification of cane juice using kieselguhr (diatomaceous earth) and decolorizing carbon.—F. W. Zerban. Previous investigators have found that nearly three-fourths of the impurities which are removed by treatment of cane juice with heat and lime, can be taken out by filtration in the cold, and that therefore the chemical effect of the lime treatment plays only a small part in clarification with this process. It was also shown by the same investigators that the greater part of these impurities exist in the juice in colloidal form. Conclusions based on these facts are further developed in this paper, and it is pointed out that the effectiveness of the various chemical clarification methods at present in use may in their broad outlines be explained by colloid-chemical considerations. It is very probable that surface energy, and particularly adsorption, is the principal factor in these clarification processes. It follows from these theoretical considerations that cane juice clarification may be brought about without the use of any chemicals whatever, but simply by the use of efficient adsorbents. Laboratory and factory tests have given strong evidence that this is actually the case, and it was found that in comparison with the sulphitation process, at least the same quantity of first-class sugar of greatly superior quality can be made by clarification with 0·5 per cent. of kieselguhr, followed by treating with 1 per cent. of decolorizing carbon ("Norit") and filtering the juice in both cases, which is easily and rapidly done. The first molasses is so very light in colour that the recovery of high grade sugar can probably be materially increased, still leaving a molasses of higher market value than that made by the usual plantation methods.

Boneblack (animal charcoal), and decolorizing carbons.—W. D. HORNE. Investigators on the preparation of boneblack (animal charcoal) and decolorizing carbons should bear in mind the practical working conditions to be met by these substances. Char or its substitutes should exist in grains of 16 to 30 mesh and should be hard, very porous, and high in adsorptive power for iron as well as for colouring substances. Carbon is not necessarily a constituent, and a more easily cleansed and revivified substance is needed. Decolorizing carbons need to be more absorbent of ash and of red colouring matters such as caramel, and cheap enough to discard after using a few times.

Among other papers presented were "Chemical Control in the Beet Sugar Industry," by S. J. OSBORN; "Filtration of Sugar Juices and Syrups," by WALTER L. JORDON; "Deterioration of Cuban Raw Sugar in Storage," by N. KOPELOFF and H. Z. E. PERKINS; and "Changes in the Analytical Ratios of Sugar during Refining," by A. F. BLAKE.

A good discussion followed the reading of the papers placed before the assembly, and this first meeting of the Sugar Section was a decided success.

The Development of the Polarimeter.[1]

By NOËL DEERR.

As one hundred years have now elapsed since BIOT made the first measurements of the rotation of the plane of polarization, it is a matter of sufficient interest to trace the development of the polarimeter from the early cruder forms into the present beautiful examples of the optician's craft. In what follows special reference is had to the polarimeter in its application to sugar analysis, and familiarity with the subject is assumed.

In the instrument used by BIOT[2] plane polarized light was obtained by reflection of diffused daylight from a mirror arranged at an angle with the incident light such that $\tan \alpha =$ index of refraction of the reflecting surface. The ray of plane polarized light so obtained was received by a double refracting prism of calc spar so placed that at the zero position the image formed by the extraordinary ray was just extinguished and its extinction formed the critical or reference position for this instrument. Passage of the polarized light through an optically active material caused the appearance of the image due to the extraordinary ray, and rotation of the calc spar prism up to the point of its extinction thus afforded means of measuring the rotation due to the optically active material under examination. It was with this very simple means that BIOT made many elementary observations of fundamental importance.

The next step in the development of polarimetry was due to NICOL[3] and is contained in his publication,[1] "On a means of so far increasing the divergence of the two rays in calcareous spar that only one image is seen at a time." The means he used was total reflection of the ordinary ray within the crystal, whereby the extraordinary ray alone emerges as plane polarized light. The prism of Nicol remains still the best means of obtaining a ray of plane polarized light and is found in every polarimeter. It has been modified and developed by Hartnack and Prazmowski,[2] by Glan,[3] Thompson,[4] and Lippich,[5] forms due to the last three mentioned being generally now employed.

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[1] Read before the Sugar Section at the 59th meeting of the American Chemical Society, St. Louis, April 15th, 1920. [2] *Annales de Chimie de Physique*, 1849, 74, 428.

[3] Of NICOL (1781–1851) little is known. After earning a moderate competence as a lecturer on natural philosophy, he led a retired existence in the society of his apparatus. He possessed extraordinary skill as a lapidary and instrument maker.

The earliest reference to the use of the nicol in polarimetry appears in a paper by Ventzke[6]. The combination here used is that of two nicols employed with white light and compensating by rotation of the analyser. The critical position was the appearance of a bright red field appearing when the yellow component of white light vibrated in a plane perpendicular to the principal plane of the analysing nicol and hence did not reach the eye of the observer. This publication also contains the first mention of the term *normal weight* as used in saccharimetry; it is there defined as that corresponding to a 25 per cent. solution of cane sugar, whence is derived the German normal weight of 26 grms. per 100 c.c.

The introduction of monochromatic light into polarimetry appears to be due to Mitscherlich.[7] His instrument was essentially that described above except that monochromatic light was used. The critical position was that of total darkness obtained when the polarization plane is at right angles to the principal plane of the analysing nicol, compensation being effected by rotation of the latter. This instrument can also be used with white light for the measurement of small rotations without serious error, still keeping total darkness as the critical position.

No one of the instruments referred to above possessed any great degree of accuracy, and it is due to Soleil and Duboscq that the first really sensible instrument is due. This instrument contains two novelties, the biquartz plate of Soleil serving to produce a delicate critical position, and the quartz wedge compensator of Soleil and Duboscq which, applicable to any source of light, enables white light to be used as the means of illumination. For producing the biquartz plate Soleil[8] recalled that Biot had observed that the yellow rays of white light were rotated exactly 90° by a plate of quartz 3·75 mm. thick and that the remainder combined to form a very sensitive rose or lilac combination called by him the *teint de passage*. Evidently in a combination of two nicol prisms with their principal planes parallel and an homogeneous quartz plate of the proper thickness, the eye of the observer will always receive the impression of a delicate rose field changing to deep red or blue as a nicol is rotated or as the position of the plane of polarization is otherwise disturbed, and the field will always remain of a uniform colour. If, however, the plate of quartz be one half of dextrose and one half of levorotary material, there will be uniformity of tint, with parallel nicols, only when the position of the plane of rotation is not altered, or when any alteration is neutralized. In all other cases there will be a contrast of red and blue in the halves of the field. The compensator[9] consists of a system of wedges of dextro and levorotary quartz whereby a definite thickness of either may be interposed to the passage of light and so may neutralize, or compensate for the rotation of the material under examination. This combination remains to-day an essential feature precisely as originally designed.

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[1] *Edinburgh New Philosophical Journal*, 1829, **6**, 83. [2] *Comptes rendus*, 1866, **62**, 149.
[3] *Reportorium fur physikalische Tecknik* (Carlsberg), 1880, **16**, 570; 1881, **17**, 195.
[4] *Philosophical Magazine*, 1881, **12**, 349; 1866, **21**, 476. [5] *Wien. Sitzungber.* 1885, **91**, 1079; 1895, **105**, 317.
[6] *Erdman's Journal fur praktische Chemie*, 1842, **25**, 65. [7] "Lehrbuch der Chemie," (4th Edit.) 1844, **2**, 36.
[8] *Comptes rendus*, 1845, **20**, 1805. [9] *Ibid.*, **21**, 248.

Of equal importance with the prism of NICOL and the compensator of SOLEIL and DUBOSCQ is the photometric method of determining the critical position, due to JELLET[1] and described by him in an article entitled "On a new analysing prism."[2] Reflecting that the position of total darkness in the Mitscherlich combination is hard to determine, he procured to be constructed a twin nicol prism with the principal planes of its halves inclined to each other at a small angle, actually in the original instrument, 7°. Evidently in a combination of polarizing nicol and such an analysing prism when one-half of the latter is in the position of total darkness to the former, the other half will pass light; similarly the other half of the field of vision may be brought to the position of total darkness by rotation of the analyser, and between these two positions there is one where the field is uniformly illuminated. This forms the critical position which is obtained by adjusting the compensating combination until the halves of the field of vision are equally illuminated. To this position the inappropriate term of "half-shadow," a slavish translation of the German "Halbschatten" has been applied, indicating that at the critical position the field is neither dark nor yet completely illuminated.

Following on his invention of the photometric principle for determining the critical position, JELLET had constructed a saccharometer embodying the principle.[3] The optical system employed in this instrument, differing from all others on record, and left unmentioned in all except some British textbooks, is described below. It consists essentially of an ordinary nicol prism as polarizer and a Jellet twin nicol as analyser. Those parts are permanently fixed relative to each other so as to obtain equal illumination in the halves of the field of vision. Close to the polarizer is a cell which can be filled with some levorotary material and thus introduce into the system a known left-handed rotation. The sugar solution under determination is contained in a telescopic graduated tube, adjustment of the length of which serves to neutralize the introduced left-hand rotation, and to give data for computation of the concentration of the sugar in the solution.

The majority of German and American textbooks evidently deriving from an error in Landolt's treatise ascribe to Jellet a construction quite different from that which he invented. His actual wording descriptive of his analysing prism is:— "A rhombic prism of Iceland spar, whose long edges should be of length about two inches, or a little more, is cut by two planes perpendicular to those edges, so as to form a right prism. This prism is divided by a plane parallel to those edges, and making a small angle with the longer diagonal of the base. One of the two parts into which the prism is divided is then reversed so as to place the base upwards and the two parts are cemented together with the surfaces of section in contact ends and the ends of the prism thus formed are then ground and polished."

Not long after Jellet had introduced the photometric principle it was further developed by CORNU.[4] He simplified Jellet's construction for obtaining a twin nicol and removed this device to the polarizer. The instrument he built compensated by rotation of the analyser and therefore employed monochromatic light. In this form, and as built by him, it remains essentially the modern general purpose polarimeter.

The arrangement of CORNU was taken hold of by German opticians, precisely as a generation previously the instrument of Soleil & Duboscq appeared in a German dress. In this case it was adapted for the use of white light by the addition of the quartz wedge compensator.

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[1] JELLET (1824-1888) sometime Provost of Trinity College, Dublin, was eminent as physicist mathematician, and divine. Of very broad scholarship he was an exemplar of the old school of University don, a type which is rapidly approaching extinction. He was also a staunch, Unionist.

[2] *Proceedings of the Royal Irish Academy*, 1863, 7, 348.

[3] *Ibid.*, 1864, 8, 279.

[4] *Bulletin de la Société Chimique de Paris*, 1870, 14, 140.

The photometric principle was again extended in France by Laurent.[1] In his instrument between the polarizer and analyser and covering one-half of the field is placed a plate of quartz cut parallel to its optic axis. Though obtained by different means the optical effect of this arrangement is the same as that obtained with the twin nicol. This instrument, originally constructed to be used with monochromatic light and to compensate by rotation, was very soon adapted for use with white light by the application of the quartz wedge compensator,[2] and instruments equipped with both means interchangeable with each other have been supplied by the makers for upwards of forty years. Nevertheless, right down to the present day the statement is frequently made, even on the highest authority, that this and some other instruments cannot be used with white light, it being entirely overlooked that it is not the means employed for obtaining the critical position that determines the nature of the source of illumination, which remains a function of the means adopted for compensation.

Two other devices for obtaining a photometric critical position remain to be mentioned; that of Poynting[3] interposing between polarizer and analyzer a plate of quartz cut perpendicular to the optical axis, one half of the plate being slightly reduced in thickness, and that of Lippich[4] which covers one moiety of the polarizing nicol with a second small nicol, and this construction is considered on mathematical grounds to be the most efficient.

The final development of the photometric method is found in arranging the critical position devices so as to obtain a tripartite in place of a bipartite field, with the object of obtaining an enhanced degree of accuracy.

An entirely distinct method for obtaining the critical position is that employed in the instrument of Wild[5] produced almost simultaneously with that of Jellet. The critical position is here obtained by a certain definite arrangement of the interference bands seen when a ray of polarized light passes through certain of those devices properly called polariscopes. Wild used a Savart polariscope[6] which was interposed between polarizer and analyser, and originally using monochromatic light, obtained compensation by rotation of the polarizer. Later he adapted this instrument for white light by employing quartz wedge compensation.[7] A very similar instrument, but employing a Senarmont[8] polariscope to obtain an interference phenomenon was at a later date devised by Trannin.[9] This instrument employed Jellet's system of compensation and was later developed into a quartz wedge compensating apparatus by Duboscq and Duboscq.[10] Neither this design nor that of Wild has ever been popular.

In following the above sketch of the development of the polarimeter it will be seen that there are three major inventions connected therewith:—The prism of Nicol, a Scotchman; the quartz wedge compensator of Soleil and Duboscq, Frenchmen; and the photometric critical position of Jellet, an Irishman. German science has contributed nothing elementary, yet the manufacture of these instruments has been allowed to become almost exclusively Teutonic; in France and in colonial localities connected therewith, French-built instruments are to be seen, but elsewhere they are rare. Now that British and American firms have commenced manufacture, it is to be hoped that this branch of the scientific instrument trade will not be allowed to again become teutonized.

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[1] *Comptes rendus*, 1878, **80**, 662.

[2] *Journal de Physique*, 1882, **1**, 552.

[3] *Philosophical Magazine*, 1880, **10**, 18.

[4] *Zeitschrift fur Naturwissenschaft.*, **30**, 45.

[5] *Mittheilungen der Naturforschenden Gesellschaft*, Bern, 1864, 27.

[6] *Poggendorff's Annalen*, 1840, **49**, 292,

[7] *St. Petersburg Academy, Scientific Bulletin*, 1883, **28**, 407.

[8] *Annales de Chimie et Physique*, 1857, **50**, 480.

[9] *Association Francaise pour l'Avancement de Science*, 1885, 105.

[10] *Journal de Physique*, 1886, **5**, 274.

Graph for indicating Boiling House Recovery.[1]

By E. W. KOPKE.

The effect of the purity of the juice or syrup and of the resulting final molasses on the recovery of sugar is of such importance, but understood by so few, that the writer endeavoured several years ago to elucidate the subject by means of a graph.

While it was not intended to do more than illustrate the conditions and results in a more impressive and interesting manner by means of this graph, it became of almost daily service to the writer. As many requests have been made for copies, the original has been extended to cover a wider range of working conditions and indicate the recovery even on the first boiling as practised in many modern factories.

It should be understood, however, that this graph is not intended to eliminate the proper calculations for determining the available recovery, though it is sufficiently exact for general purposes of comparison.

It is apparent that the recovery of sucrose in the juice, as illustrated in this way, does not provide for such losses as occur in the press-cake or any losses other than those in the molasses.

For estimating the available sucrose in juice, the apparent purities do not suffice, and "gravity purities" are considered at present the most practical. The gravity purity of the syrup is generally 0 8 per cent. higher than the apparent purity, while the gravity purity of molasses is from 3 to 7 or 8 per cent. higher than the apparent purity under average conditions. These data should be actually determined, however, especially in the case of the final molasses, as the apparent purities are frequently misleading. The results are based on the *S. J. M.* formula, established by NOËL DEERR,[2] which has been found by wide application to provide a very reliable check on the actual results. The gravity purity is:—

$$\frac{\text{Sucrose (not polarization)}}{\text{Brix}} \times 100.$$

Each degree of syrup purity (that is gravity purity) is represented on the graph by a curve; so that, knowing the purity of syrup and final molasses, the result is found by following the corresponding curve to the vertical molasses line, projecting the point of intersection to the right or left extreme margin, and reading the figure indicating the recovery.

Knowing the recovery and syrup purity, the point of intersection will show the corresponding molasses value at the top or bottom margin. In the same way, knowing the final molasses purity and recovery, the corresponding syrup purity can be determined.

It will be observed that a difference of 1 per cent. in the purity of the final molasses has a much greater effect on the recovery when the syrup purity is low than when it is high. Also, for a molasses of constant composition, variations in the purity of the syrup give a fairly constant proportional variation in the recovery.

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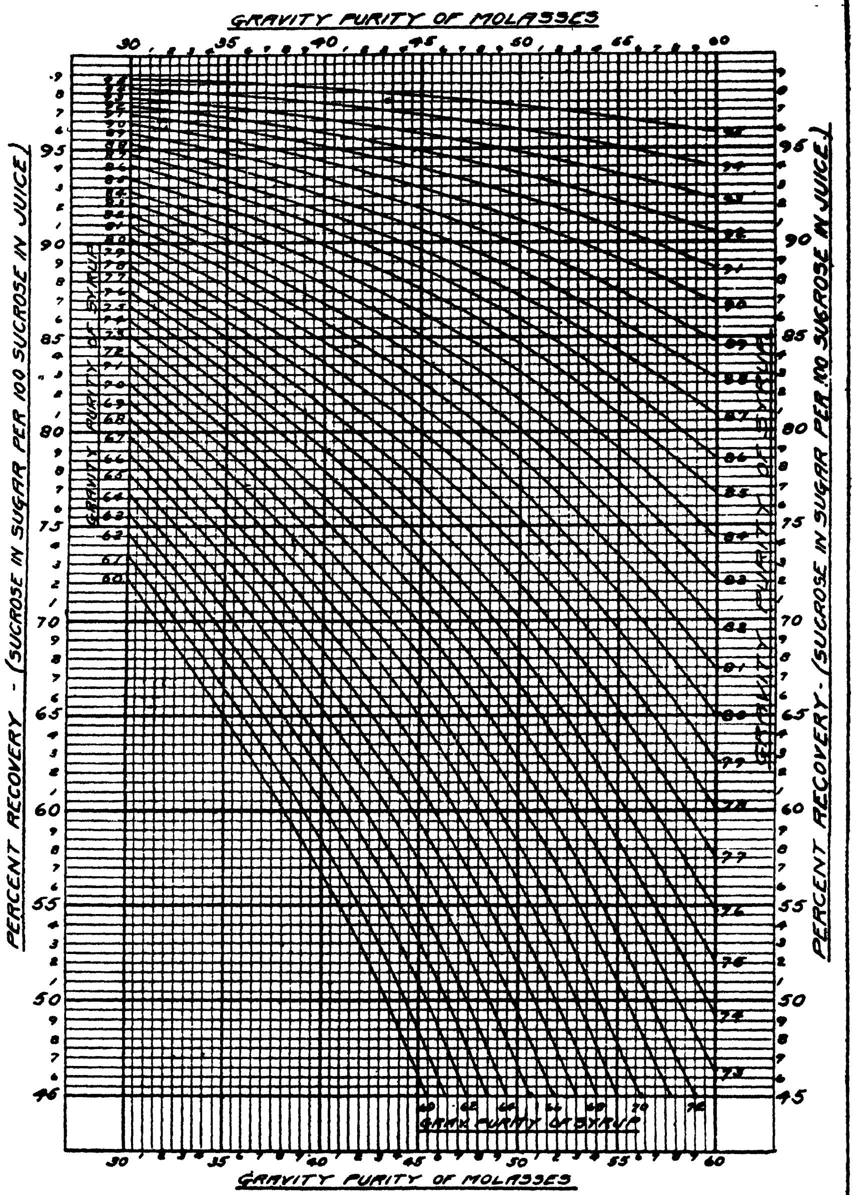
[1] *Sugar News*, 1920, 1, No. 7, 14-17.

[2] "Cane Sugar." NOËL DEERR. Page 509.



RECOVERY OF SUCROSE IN JUICE AS INFLUENCED BY THE PURITY OF SYRUP AND MOLASSES.

QUALITY OF SUGAR - CONSTANT - 97.5 GRAV. PURITY

E. W. KOPKE

Graph for Indicating Boiling House Recovery.

While the average gravity purity of the final molasses from modern factories in the Philippine Islands is probably not lower than 40·0 or 42·0°, it is possible to reduce this value further in the laboratory to about 30·0° gravity purity. This is a phase of sugar manufacture that deserves much more study and investigation than it has received in the past.

That this subject is but slightly understood by the majority of sugar men is exemplified by the frequent heavy expenditures for higher mill extraction while greater possibilities at the other end of the factory are overlooked.

American Commerce Reports.[1]

RESTORING THE FRENCH BEET SUGAR INDUSTRY.

The reconstruction of French sugar mills presents the greatest opportunity for the sale of American machinery that was observed by the writer during his investigation in Europe. Immediately after the armistice, before the rate of exchange reached a point that discouraged negotiations, it seemed that the situation favoured American participation in this work and that even when credit would be necessary in order to secure contracts it would be possible to make arrangements satisfactory to both principals. Although American machinery manufacturers of recognised standing investigated the possibilities, very little business seems to have resulted. European concerns, on the other hand, have been very active ; and it is reported that contracts for sugar-mill machinery have been let by the French to machinery builders in France, Belgium, Switzerland, Czechoslovakia, Germany, and perhaps also in England. This fact should not be discouraging to any concern interested in extending credits and obtaining orders for American-built sugar-mill machinery, because the amount of work to be done is greater than the capacity of European production. If the European shops should attempt to manufacture all the sugar-mill machinery needed within a short-time, other industries would be neglected. The job is clearly large enough for participation by everyone who may be in a position to assume a share of it.

That factor that will determine the amount of business that Americans will be given the opportunity to do (granting that the terms required can be agreed upon) is the question of what value the French will place on time. This has been the critical point in many negotiations between the Americans and the French. When the French policy indicates that an attenpt will be made to have all the work done by Frenchmen in France, regardless of the time required, the American may be inclined to feel that what he has to contribute—namely, facilities for expediting the job—is underestimated to such an extent that further efforts to take part in this reconstruction would be fruitless. Perhaps the war has produced an emergency that will change this policy of underestimating the value of time.

Talks with progressive French business men indicate an ardent desire to encourage assistance from foreign concerns that have facilities to offer, in order that French industry may resume full operation as soon as possible.

One report refers to a plan for building 10 sugar mills a year for 10 years. Assuming that 100 new mills will restore production to a point that will supply French consumers without providing anything for export, 10 years seems a rather long time, in view of the present high price of sugar, which offers every inducement for mills to hasten preparations to take advantage of it and which, moreover, can not be expected to continue indefinitely.

Before the war France produced about 800,000 tons of beet sugar per year and consumed approximately 700,000 tons of this output. At the present time enough mills remain to produce at the rate of approximately 100,000 tons of sugar per year, while the consumption of sugar in France, as in all other countries, has risen so that about 1,000,000 tons would be consumed annually if it were available. To supply this deficit of nearly 900,000 tons per year France must import sugar at high prices or do without it. Every sugar factory that resumes operation reduces the outside purchases of France and supplies a necessity of life that can be sold by Frenchmen to Frenchmen at a profit. The prospects of this industry can be estimated, therefore, with a considerable degree of accuracy.

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[1] Culled from "Commerce Reports," published by the Department of Commerce, Washington. In many cases these are abbreviated here.

The machinery required by the sugar factories includes slicing machines, diffusion apparatus, steam boilers, filter presses, centrifugals, mechanical conveying equipment, vacuum-pans, and beet-harvesting machinery. Perhaps the first two items—slicing machines and diffusion apparatus—can be obtained in Europe within a reasonable time. All the other items, however, have been the subject of inquiries as to their availability in America. American centrifugals are favourably known in France as having proved to be satisfactory in sugar work. One French sugar manufacturer expressed particular interest in beet-harvesting machinery from the United States. He stated that the French were decidedly backward in agricultural labour-saving machinery, and that if Americans could offer such machinery for harvesting beets there would be an immediate demand for it.

The organization of the sugar industry differs from that of other large French industries, which are syndicated, and it therefore offers an opportunity for dealing with individual institutions. This should be favourable to American interests, because the mill that wants to go ahead with assistance from outside is not held back by other mills that do not approve of the idea. The sugar industry is an agricultural industry—an adjunct of the farm. Many of the sugar mills are owned by the farmers that raise the beets for them. These co-operative societies have been earning enough to satisfy the owners, who have been very independent.

The following, quoted from the report of the International Trade Relations Society, A.E.F., was written by an experienced American sugar-mill engineer who had exceptional facilities for ascertaining conditions in the French sugar industry :

"During the 1914 advance of the German Army very little damage was done to the sugar industry ; but, on the other hand, because of the great scarcity of metals and materials in Germany in 1917 and 1918 every factory which was behind the 1918 line of maximum advance was absolutely stripped of all copper, brass, bronze, belting, rubber, and electrical equipment. The copper coils, brass plates, and bronze tubes of pans, evaporator effects, juice heaters, etc., were removed, sometimes by unbolting the bottom of the pan or effect and letting it fall to the floor below and then removing tubes, coils, etc., through the bottom, and often by tearing away the insulation and cutting a large section out of the side of the pan or effect by means of an oxy-acetylene flame and removing the copper and bronze from the interior through this hole. The sugar boiler's brass trysticks, the brass stuffing boxes, the brass frames of peep glasses of pans, evaporator effect, etc., the copper-lined spouts and troughs of juice filter presses, all centrifugal screens and back screens, all brass and bronze bearings on engines, pulley shafts, etc., were removed by unbolting, breaking off, etc. All electric generators, motors, distribution boards, etc., were removed, which loss in various cases amounted to 16, 25, 50, and as high as 65 motors for one factory.

"The French factories were, in general, good factories and compared quite favourably with the general run of American factories. Machines were well made, well installed, and conservatively operated. In France a sugar factory works about 90 to 110 per cent. of its rated capacity. The beet-sugar factories of our largest American firm handle, year in and year out, about 170 per cent. of their rated capacity

Consequently, it can be seen that to produce a given quantity of sugar requires more machinery and equipment in France than in America.

"There exists a contrast between French and American methods in the matter of "raperies," or juice annexes. In America very few juice annexes exist (probably only the one in Idaho), but in France they are quite general. The 142 destroyed factories in northern France had 70 juice annexes—one in particular, near Cambrai, a 3,000-ton mill, having 14 juice annexes situated around the central factory, at distances varying from 1 to 15 miles. These annexes have boilers, cutters, and a diffusion battery, and pump the diffusion juices through a small pipe line to the central factory.

"Another contrast exists in the matter of product. While practically all the American sugar factories and refineries, even the smaller beet-sugar factories in the West, produce white granulated sugar, the general run of French factories produce white crystals, or No. 3 sugar, which is shipped to a refinery. The refineries put out very little white granulated sugar, their product being in the form of domino sugar or cubes. The largest refinery in France puts all of its 1,500 tons per day through the "Adant system," of which the product is 85 per cent. domino and the remaining 15 per cent. powder and small broken lumps incidental to the manufacture of domino.

"The coast refineries that handle the raw cane sugar from Africa and the French colonies made principally the "Pain de Sucre," or sugar loaf, a hard, conical lump of refined sugar, weighing 4·4 lbs. This product is demanded principally by the colonial trade.

"The French manufacturers and refiners make and sell whatever their trade demands, which, so far, has been principally the sugar loaf and domino ; and it is quite likely that when bans are lifted, so that they can buy machinery and equipment outside, they will proceed to re-establish along the same general lines that existed before the war. Reconstruction presents enormous difficulties and will doubtless entail long delays, but sooner or later the French factories will be rebuilt." [Extract from Report of American Trade Commissioner].

A war-time process adopted in Germany for the manufacture of sulphur from calcium sulphate is said still to be carried on because it gives a high yield at a smaller cost than the imported material, the several stages being as follows : Calcium sulphate is roasted with coal ; the resulting calcium sulphide is boiled with a solution of magnesium chloride, hydrogen sulphide being liberated ; lastly on mixing together the hydrogen sulphide and sulphur dioxide, all the sulphur is liberated, according to the equation : $H_2S + SO_2 = 3H_2O + 2S$. Both the raw materials occur in the potash salt deposits, and are of very little value for other purposes. About 23,000 tons of sulphur are stated to have been made by this interesting process.

A continuous CO_2 recorder which does not involve the use of any chemical reagents, and is claimed to be accurate and sensitive, has been placed on the market. It depends on the method devised by Dr. G. A. SHAKESPEAR, of the University of Birmingham, for testing the purity of gases, using an instrument known as a "katharometer," which consists of two identical spirals of platinum wire contained in two cells drilled in a copper block, each of the spirals being connected to form one arm of a Wheatstone Bridge circuit. On allowing a fairly large current to flow in this circuit, the two spirals become heated, losing heat to the walls of the cells. The rate of cooling depends on the thermal conductivity of the gases in the cells, in this case air and flue gas (assuming flue gas to be a mixture of air and carbon dioxide) and the difference in the temperature of the two wires causes a deflection in a galvanometer, the extent of which is an indication of the amount of the second gas (carbon dioxide) present. The galvanometer is calibrated directly to record the percentage composition of the flue gas, and an advantage is that, while the katharometer may be in close proximity to the furnace flue, the continuous recorder may be some considerable distance away, in the superintendent's office, for example.[1]

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[1] See also E. R. Weaver and others, *J. Ind. Eng. Chem.*, 1920, **12**, 359–366.

Publications Received.

Reports of the Progress of Applied Chemistry, Vol. IV. (Society of Chemical Industry, Central House, London, E.C. 2.) Price, 5s. 6d. to members of the Society; and 12s. 6d. to non-members (post free). 1920.

We have pleasure in calling attention to the issue of Volume IV (1919) of the Annual Reports of the Progress of Applied Chemistry published by the Society of Chemical Industry. As was pointed out on the appearance of previous issues,[1] their purpose is to summarize the work done during the year in the several branches of chemical technology in such a manner as to allot to each research and invention its proper place in the chronicle of progress. They are found valuable in enabling those specializing in a particular branch to follow the trend of other directions of activity. Their publication has met with considerable success, showing that they supply a want which must have been generally felt amongst chemists.

In the present volume the various divisions comprise the reports covering the whole range of chemical technology, sections on explosives and analytical chemistry having now been added. "Sugars, Starches and Gums" has been prepared by Mr. J. P. OGILVIE; and contributions of particular interest on connected subjects are those on Agricultural Chemistry by Dr. E. J. RUSSELL, F.R.S.; Fermentation Industries, by Messrs. A. TAIT and L. FLETCHER; Plant and Machinery by Dr. W. B. DAVIDSON; Fuel by Dr. J. T. DUNN; Foods by Dr. H. W. BYWATERS.

Beet Top Silage, and other By-products of the Sugar Beet. By James W. Jones. Farmers' Bulletin, 1095. (Bureau of Plant Industry, U.S. Department of Agriculture, Washington, D.C.) 1920.

Directions are given in this Bulletin for the construction of pit silos, and the gathering and soloing of beet tops. It also makes suggestions in regard to feeding the silage, molasses, and pulp, based largely upon the reports of beet growers and stock feeders. Beet top silage has been found by farmers in the United States to have a a value about one-third to one-half that of alfalfa hay; while it is also well-suited for the dairyman and the feeder of beef cattle and sheep. When it is fed for the production of beef or mutton, the hay requirements may be reduced 50 per cent. Furthermore, the warm succulent material seems to stimulate the appetite of the animals, causing them to consume and utilize larger quantities of feed. Beet pulp and molasses, by-products which have an established value with stock feeders, should be fed with a moderate allowance of hay or any other feed in order to make a balanced ration. Animals not accustomed to beet top silage should be given a small quantity at first, and the feedings gradually increased until the normal amount is reached.[1]

Report of the Fuel Research Board for the Years 1918 and 1919. Department of Scientific and Industrial Research. (H.M. Stationery Office, Imperial House, Kingsway, London, W.C.2.) 1920. Price: 1s. 8½d. (post free).

This Report deals with the following subjects: The immediate importance of fuel economy; oil fuel for the navy and the mercantile marine; description of the Fuel Research Station and its functions; survey of the national coal resources from the physical and chemical points of view; domestic heating; air pollution; pulverized coal; peat investigations; alcohol as fuel; and gas standards. There is also an article on "Fuel Economy and Low Temperature Carbonization" by Sir

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[1] *I.S.J.*, 1917, 374; 1919, 34; 1919, 296.

[1] See also *I.S.J.*, 1920, 111.

George T. Beilby, F.R.S., published as an appendix. In regard to fuel alcohol, it is stated that the Fuel Research Board propose to begin their study of this matter by bringing the work already done on production and utilization into proper focus, and Sir Frederick Nathan has been appointed Power Alcohol Investigation Officer. It is obvious that until an estimate has been made of the possible sources for the supply of alcohol within the Empire, and until their probable amount and the cost of using them have been ascertained, it would be useless to embark upon research on any extended scale into methods of production or utilization.

Report on the Tractor Trials held at South Carlton, Lincolnshire, September 24th to 27th, 1919. (Issued by the Society of Motor Manufacturers and Traders, London: 83 Pall Mall, S.W.1.) 5s. net.

This, the Official Report of the Technical Adviser and the Judges at the Tractor Trials held in this country last Autumn, is probably the most comprehensive description of the design, merits, and accomplishments of the leading makes of motor tractor that has ever been compiled. No attempt is however made to place the 56 machines entered in order of merit, but a technical description of each entrant (with an illustration of the machine) is given, and the respective defects and merits are indicated as far as these particular trials revealed them. Tables are also given showing the results obtained by the tests in a variety of conditions and giving all the leading dimensions of the competing motors. The technical adviser in summing up the mechanical construction of the entrants states that in general details most of the machines were perfectly sound, but in some cases access to parts requiring attention for adjustment, etc., had not been kept in view by the designer. The Judges concluded their own report of the trials with the view that these have demonstrated that while tractors have not yet reached a stage of perfection, they have made considerable progress in recent years; but the implements for use with them have not advanced in the same proportion. As to the lessons conveyed by these trials, we reproduced last November (from the *Journal of the Board of Agriculture*) a useful summary of the conclusions drawn, to which reference may profitably be made, even if the reader secures for himself a copy of the official report.

Oxford Correspondence Courses. (Oxford Correspondence College, Ltd , 65, St. Giles, Oxford.)

Attention is directed to a series of correspondence courses of a particularly high standard dealing with a variety of important subjects. These courses are not prepared for the specific purpose of enabling students to pass any particular examination. They have been written by well-known Oxford professors and tutors, and with the object (it is stated) of imparting something of the wide culture, the originality of thought, and the critical judgment that are inspired by the system of education of the world-famed university. It is in fact claimed by those promoting the scheme that the Correspondence College enables one to secure at home those advantages of an Oxford education which many have sacrificed much to obtain, and of which many men and women feel the deprivation. Thus there is the Oxford Culture Course, which "aims at enlarging the mental horizon, enriching the spirit of the student, and enabling one to discuss with intelligence and originality the various interests and problems of life." Also there is the course on the Study of English Literature, in which prose fiction, poetry, the essay, oratory, satire, political science and other branches of the subject are examined and criticized in a scholarly yet interesting manner, giving the reader the information necessary for realizing a proper appreciation of the treasure-house of books. There are also courses on Economics, and Modern Business and Finance (both of particular importance at present in view of the conditions prevailing throughout the world), on English History, Logic, Philosophy, Political Science, Biology, and Physics. The lectures, essays, and treatises comprising the correspondence courses are sent out in 15 fortnightly instalments, each being accompanied by a paper of questions, which are reviewed by a tutor and returned with advice and criticism. Further information and copies of prospectuses and pamphlets are obtainable from the Warden of the College at the address given above.

Correspondence.

THE DIFFUSION OF SHREDDED CANE.

To the Editor, "The International Sugar Journal."

Sir,—Mr. A. **Fries** in an article in your February issue quotes Mr. J. N. S. **Williams** as saying, "If shredded cane be used for diffusion, this may solve the problem of preparing the material." I do not know what cutters were used in Hawaii ; apparently they were not very satisfactory, but if a "Fives-Lille" cutter with properly ground knives, changed twice a day only, had been used I do not think he would be worried on that point.

As every diffusion worker knows, a clear cut slice of beet, or cane, with the minimum of broken pieces and crumbs, which will pack evenly leaving no channels, is the essential factor for good exhaustion without undue dilution, and that the Fives-Lille cutter, with hollow ground blades of the plane-iron type and with well-filled hoppers allowing no dancing of the canes, will give. An exhaustion to 0.1 in the exhausted slices is easily obtained in a 16-cell battery and would only be advisable with a pure juice.

As to the suitability of diffusion chips for fuel, after passing through a 6-roller mill with a moderate pressure and being fed with a screw feeder on to the half-cone grate of a "Godillot" furnace, in my experience they burn perfectly without any auxiliary fuel in the same furnace, except after cleaning. I do not know how much extra fuel has been needed elsewhere, but when I worked the plant in question 20 years ago, slicing over 300 tons per 24 hours and providing fuel for a workshop and locomotives, and steam for a large distillery with rectifier, the daily consumption of poor quality wood-fuel was reduced to nearly 10%. Pressing the work up to 350 tons of course still further reduced the percentage.

It is so much a question of due attention to economy of heat produced in the first installation of a plant, by covering all hot surfaces, including juice and syrup tanks, saving of all hot-water produced including all that from the several cells of the evaporator and much of that from the cooling waters of factory and distillery, and economy in using the steam produced, correct arrangement of flues and furnaces—in all of which details but the last we were very behindhand—that it is difficult to compare one factory with another, especially at a distance ; but compared with the majority of factories in the district the diffusion factory had no cause to envy others in the matter of auxiliary fuel, at that time.

Freedom from serious breakdowns is one great advantage in diffusion, a piece of iron in a bundle of canes being the worst thing to fear ; but with a 10 minutes stoppage to replace knives and sufficient spare knives on hand it can be remedied. The chip mills are not pressed sufficiently to render breakdowns likely.

The amount of 10 tons of firewood to 100 of canes worked may seem very high to some of your readers, but there are many deductions and allowances to be made for difficulties that should not be met with in a well-equipped modern factory and under other conditions. The fuel was of poor quality and much had lain for months in wet lowland ; the supplies for the distillery, the locomotives and fuel for all the personnel on the place are included. Boiling was all done with direct steam in the pans and three jets of sugar, the first being fine white, were made.

Taking all things into consideration I do not think that diffusion ever had a really fair trial, and I take it that the scattered nature of the various attempts had something to do with this contretemps.

Yours,

Alfred J. Watts.

Pernambuco, Brazil.

Brevities.

The Dyer Company of Cleveland, well-known American builders of beet and cane sugar plants, have just booked a contract with the Nippon Sugar Company of Tokyo, to erect and equip a 600-ton beet plant with pulp dryer and Steffens house installation.

The Commercial Secretary to H.M. Legation in Havana reports that a British commission agent, resident in Camagüey, Cuba, is desirous of representing United Kingdom manufacturers for the sale of the following classes of goods: jams and preserves, biscuits and confectionery (Ref. 676).

The *Zeitschrift für Zuckerindustrie in Bohmen* now appears as the *Zeitschrift für Zuckerindustrie der cechoslovakischen Republic.* It is published by the Zentralverein der cechoslovakischen Zuckerindustrie, of Prague, and is edited by Dr. FRANZ HERLES. It prints the *Prager Zuckermarkt* as a supplement.

An epidemic of arsenic poisoning which visited a country town in Surrey recently was traced to a leaking drum of weed-killer having been placed for railway transit in contact with a sack of sugar which latter absorbed some of the liquid; the result was that about sixty persons were subsequently treated for poisoning.

The Minister of Agriculture has appointed Sir JAMES MARTIN, senior partner of Messrs. MARTIN, FARLOW, & Co., a firm of chartered accountants in London, to be the financial representative of the Government upon the board of directors of Home Grown Sugar, Ltd., the company owing the Kelham beet sugar estate.

Barter is much in vogue on the Continent in the manner of exchanging needs, and an instance is given where the Czechs delivered 7,500 tons of sugar to Germany for 1,386 railroad trucks. Again, it is reported that Poland is being supplied with fertilizers in return for an undertaking to deliver to the United Kingdom a certain quantity of bee sugar.

The American Sugar Refining Co. have now given the order for the projected Central Jaronu, Cuba, which (it is stated) will be a duplicate of the Cunagua factory already purchased by this concern; while the Warner Sugar Refining Co. have purchased Centrals Gomez Mena and Amistad, the price paid for the latter two being reported to be about $16,000,000.

R. DUTILLOY[1] claims good results in the beet factory by treating the raw juice with hydrosulphite (prepared in the factory by the Descamps process) previous to liming and carbonation, the syrups being later well sulphited. It is claimed that this hydrosulphite treatment greatly decreases the viscosity of the several products, facilitating filtration, evaporation, crystallization, and curing.

It is stated that a refinery at Algodones, Camaguey, Cuba, is now in course of construction, the capacity of which will be about 2000 tons per week. It was at first intended to build a char house only; but the owners of the Algodones Sugar Co., who also control the Central at Algodones, have decided in favour of a complete independent refining plant. It is reported that another refinery is being planned for erection near Regla Bay, Havana.

Mr. HANNIBAL J. DE MESA is insistently urging Cuban planters to build refineries, and withdraw raw sugars from the market at the current price, which he states is entirely too low for the existing demand. He says: "Can it be possible that we persist in this shameful attitude simply because lacking refineries we cannot sell white sugar to-day at 15 cents. per lb., or the equivalent of 12 cents. for our raws, and continue to give away our raws at 10½ cents?"

One of the principal uses to which the so-called rare sugars are put is the differentiation of bacteria. Owing to the large demand for one of these, viz., *d*-mannitol, the U.S. Bureau of Standards undertook at the request of the U.S. War Department the production of a considerable quantity. A method was developed whereby a pure sugar could be obtained from manna in two crystallizations only, thus enabling the production of a large quantity at a comparatively reasonable cost.

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[1] *Bulletin des Chimistes de Sucrerie de France*, 1919, 37, 68-73.

Review of Current Technical Literature.[1]

ACTIVATION OF WOOD CHARCOAL BY HEAT; PREPARATION OF DECOLORIZING CARBON; INCREASING THE DECOLORIZING POWER OF ANIMAL CHARCOAL BY HEATING.

James C. Philip, Sydney Dunnill, and Olive Workman. Journal of the Chemical Society, 1920, Vols. *117 and 118, No. 690, 362-369.*

In a previous investigation,[2] the observation was made by one of the authors that the absorptive power of wood charcoal is notably increased by prolonged heating, and the present paper contains a record of work carried out with the object of elucidating the extent and mechanism of this effect,[3] as exhibited towards (*a*) sulphur dioxide and (*b*) methylene blue in aqueous solution. One of the first observations made was that the duration of heating is not the main factor in determining the degree of activation; but that the clue is to be found in the alteration of the bulk density[4], and experimental evidence here given shows clearly that the order of activity corresponds with the order of the bulk density. Activation appears to be intimately connected with the extent to which the charcoal is oxidized during the heating. Thus, when the charcoal is heated in a crucible for a long time, and the portion in the bottom is separated from that in the top of the receptacle by a layer of asbestos (being in this way protected against circulation of air), the product above has a lower bulk density and a considerably greater activity than that below. In order to demonstrate this point more conclusively, charcoal was freed from air by a current of nitrogen in a furnace and heated for 20 hours, at the end of which time it was found that both absorptive power and density were practically unaltered, though probably even under these conditions a slight oxidation could not be precluded.[5]

According to the view of the writers, the heating of charcoal results by progressive oxidation in the widening of the capillary channels with which it is riddled; so that, though the external volume of a piece or granule of any determined size is practically unaltered, its bulk density is diminished and the effective surface is enormously increased. It follows, therefore, a charcoal of low activity has extremely narrow capillaries, and the deposition of a comparatively shallow layer of gas molecules on the surface will block the capillaries cutting them off from further participation in the adsorption process. In an activated charcoal, on the other hand, adsorption proceeds along the walls of these internal capillaries, as well as on the external free surface of the material. An important observation made by the authors is that the increase in the adsorptive power of wood charcoal for gases effected by continued heating is paralleled by a marked increase in the decolorizing power of the preparation as exhibited towards methylene blue in aqueous solution,[6] and experimental results showing this are given. It is of interest to quote some of these demonstrating the relation between time of heating and the decolorizing power in the case of Japanese ash charcoal carbonized at 925° C. and heated for different periods at a temperature of 830° C.:—

Time of heating, hours...	1	12	28	34	42	49
Dye removed, per cent...	0·6	14·7	24·4	42·5	51·8	60·3

while a sample of commercial animal charcoal removed 17·8 per cent. under the same conditions. Attempts have been made by different workers to correlate the decolorizing power of a charcoal with its nitrogen content,[7] but the present authors consider the probability of any such relationship as small in view of the figures given above. It is mentioned that the efficiency not only of wood charcoal but also of animal charcoal itself is a function of the heat treatment it has received, and that it can be increased to a very notable extent. Thus the sample of commercial animal charcoal which removed 17·8 per cent. of methylene blue from solution, after being heated for 18 hours at about 800° C. removed 69·6 per cent. It is stated that special preparations as "Eponit" exhibit a similarly considerable increase in their decolorizing power as the result of heat treatment. As to the temperature at which the wood or charcoal must be heated to bring about activation, in should be 800°C. or above for any rapid improvement to take place. Regarding the texture of the wood, it was found that, whilst the light woods (as willow or poplar) were activated more rapidly, they were ultimately surpassed in activity by charcoals derived from denser woods (as box).

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[1] This Review is copyright, and no part of it may be reproduced without permission.—(Editor, *I.S.J.*)

[2] *J. Royal Society of Arts*, 1919, **67**, 128.

[3] ARNO LOTZ (German Patent, 250,741) and C. E. COATES (*I.S.J.*, 1919, 619) have also noticed this fact.

[4] *Cf.* LAMB and others, *J. Ind. Eng. Chem*, 1919, **11**, 427.

[5] *J. Chem. Soc.*, 1913, **103**, 461.

[6] In carrying out this test, 0·5 grm. of the char was shaken for three hours with the solution of methylene blue, the excess of which remaining was titrated against titanium chloride.

[7] *Cf. I.S.J.*, 1920, 91.

DETERMINATION OF THE CARAMEL CONTENT AS A MEANS FOR ESTIMATING THE SUGAR LOST BY SUPERHEATING, PARTICULARLY IN REFINERY CONTROL. *Th. Koydl.* *Österr.-Ungar. Zeitschrift für Zuckerindustrie, 1918, 47, 16-39.*

It is proposed to estimate the loss during boiling, particularly in refinery control, by observing the increase in colour of the products, it being assumed that when sugar is destroyed by overheating a definite amount of "caramel" is produced.[1] Ehrlich's *saccharan*,[2] a product stated to be of constant composition and colouring power, resulting when sucrose is heated to 220° C. *in vacuo*, is used as the basis of the determination; and STAMMER's colorimeter is the instrument chosen for observing the increase in the depth of tint. A "normal" solution of saccharan contains 10 mgrms. in 100 c.c. of water; it reads 2·5 degrees Stammer, and the number of mgrms. of saccharan in 100 c.c. are termed so many "degrees Ehrlich," 1° Stammer being equal therefore to 4° Ehrlich. It is further assumed that in the production of 1 part of saccharan, 4 parts of sugar are destroyed. In an example given, 50 grms. of a product were made up to 250 c.c., which solution read 10·5° Stammer, or $10{\cdot}5 \times 4 = 42°$ Ehrlich; this was equal to $42 \times 250/100$ or 105 saccharant units, corresponding to 104×4 or 0·42 grm. of destroyed sugar in the portion taken for the examination, or $0{\cdot}42 \times 2 = 0{\cdot}82$ per cent. of the sample.[3] Applying this method of estimation to the working of (1) white sugar massecuite; (2) raw sugar massecuite; and (3) after-product massecuite in a beet factory, the sugar destroyed by the production of "caramel" (by superheating on coils and other surfaces) was found to amount respectively to (1) 0·058; (2) 0·039; and (3) 0·833 per cent. of the dry substance of these massecuites.

REMOVAL OF CALCIUM SALTS FROM BEET JUICES. *Vl. Stanek.* *Zeitschrift für Zuckerindustrie der Cechoslovakischen Republik, 1919, 44, No. 7, 45-47; No. 8, 53-58.*

One of the most troublesome circumstances of the unusually difficult beet campaign of 1918-1919 in Bohemia was the high content of lime salts remaining in the juices after clarification, caused principally by working with frozen and partly rotten roots containing a comparatively large amount of invert sugar and decomposition products. Boiling the low products strikes could indeed hardly be carried out. In order to ameliorate matters, it became necessary to investigate the conditions under which the elimination of the lime combined with organic acids could best be accomplished in the factory. A good deal has been written on this question; and the papers by HERZFELD,[4] SIQUEIRA,[5] JESSER,[6] PELLET,[7] and others, indicate in general that sodium carbonate must be employed, and that it must be added in more than the equivalent quantity, say an equivalent and a half, if all the lime is to be precipitated. A series of careful experiments was made by Mr. STANEK, in order to ascertain the position as precisely as possible, and the main conclusions at which he arrived are as follows:—

When milk-of-lime alone (with no sugar present) was carbonated at boiling point to a slight alkalinity, filtered, again carbonated (this time to neutrality to phenolphthalein), and again filtered, the amount of lime remaining in solution was 1·7 mgrms. of CaO per

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[1] This is not strictly true, since colourless and volatile products also arise; while the depth of colour of the substance produced by the decomposition of a certain amount of sugar may vary according to the conditions of working, the degree of alkalinity, for example.

[2] *I.S.J.*, 1910, 84-85.

[3] Provided, of course, no other colouring matter than "caramel" was originally present.

[4] *Zeitsch. Ver. deut. Zuckerind.*, 1891, 276.

[5] *Ibid.*, 1891, 284.

[6] *Österr.-Ungar. Zeitsch. Zuckerind.*, **23**, 275.

[7] *Bull. Assoc. Chim. Sucr.*, **9**, 309.

100 c.c. A 15 per cent. solution of sucrose treated under the same conditions gave a higher result, namely 3·9 mgrms., which may be due to the greater solubility of calcium carbonate *in statu nascenti* in sugar solution than in water alone[1]; or to the action of the calcium hydroxide or carbonate in the sucrose or invert sugar in forming organic acids. When a solution containing 30 grms. of sucrose, 4·0 grms. of free lime and 13 mgrms. of sodium carbonate in 200 c.c. was double carbonated at boiling point, the lime remaining was 1·0 mgrm. per 100 c.c. only; while when the soda was added to excess *no trace* of lime could be detected in the filtered liquid. Following this, tests were made with solutions containing calcium organic acid salts, as calcium saccharate, pectate, and glutamate. It was shown to be impossible quantitatively to precipitate the lime by simply boiling with the equivalent quantity of sodium carbonate. Satisfactory results were, however, obtained when the addition was made simultaneously with the double carbonatation, that is, when milk-of-lime and one equivalent of sodium carbonate were added, the liquid carbonated, filtered, again carbonated, and finally filtered, only 2·0 mgrms. of CaO being found to remain unprecipitated. Since sodium carbonate could not be used on the factory scale, owing to the scarcity of soda ash at the time, trials were made with sodium sulphite (of which there was a sufficiency, obtainable from glycerin fermentation factories). Very similar results were obtained; that is, the lime retained varied from 2·0 to 2·5 mgrms. Points worthy of note that emerged in these experiments are that the precipitation of the lime salts by soda is more complete at boiling point than at about 70° C., as JESSER[2] had indeed found; and that the addition of a larger quantity of lime than is usually used in carbonatation also aids the precipitation of the calcium organic acid salts. Lastly, it may be mentioned that all these results obtained in the laboratory with artificial solutions were confirmed by working with beet juices and imitating large scale practice as closely as possible.

PSENICKA'S METHOD FOR THE CARBONATATION OF BEET JUICES. *Vl. Stanek. Zeitschrift fur Zuckerindustrie der Cechoslovakischen Republik, 1919, 44, No. 11, 73-76.*

Psenicka's carbonatation method[3] is a very good combination of Kuthe-Anders', in which some of the scums are added during liming, and Kowalski-Kozakowski's, in which the raw juice is preliminarily heated with a small amount of lime and separated, the rest of the lime being added later.[4] It consists in mixing the raw juice with 10 to 20 per cent. of its weight of unfiltered carbonated juice containing scums and about 0·5 per cent. of lime, this mixture being heated to 85°C., treated with 1 to 1·5 per cent. of lime, and carbonatated to an alkalinity corresponding to 0·08 to 0·10 per cent. of lime (CaO). A second carbonatation follows after filtration, but without any further addition of lime. This procedure has been found to give very satisfactory results by facilitating filtration, and by enabling the total quantity of lime to be reduced from 2·5 to about 1·5 to 2 per cent., the explanation of this being that part of the lime in ordinary carbonatation is added only to provide a sufficient amount of calcium carbonate to make a grainy precipitate. Experiments carried out at the Modrany factory, Czecho-Slovakia, have shown the purity to be raised (94·60 to 94·95°), the soluble ash lowered (0·40 to 0·36 per cent.), and the colour improved (1·8 to 1·5° Stammer) compared with the ordinary procedure; while the scums were firmer, and more readily washed. That was when the total lime used was 2·1 per cent., for when an attempt was made to diminish it to 1·6, the results were not so good. This method is considered to be especially useful when frozen or rotten roots are being sliced.

ALCOHOLIC FERMENTATION OF CONCENTRATED SUGAR SOLUTIONS BY *ZYGOSACCHAROMYCES*. *Jan Satava. Zeitschrift fur Zuckerindustrie der Cechoslovakischen Republik, 1919, 44, No. 15, 93-97.*

It is generally accepted that concentrated sugar solutions are not readily subject to spontaneous decomposition, and that a density of about 80 per cent. affords complete security against fermentation. In this connexion it may be recalled that Henneberg[1] carried out a series of experiments with a large number of technical yeasts, finding only three capable of producing even a small amount of alcohol in the case of 60 per cent. solutions. Lindner[2] isolated a yeast from lager beer capable of fermenting malt wort at 53–54 per cent. solids, and called it *Saccharomyces Baillii*. Dubourg[3] found a yeast in sauterne wine which caused the fermentation of solutions of invert sugar containing 62 per cent. of solids. Then Zopf[4] discovered a yeast in the syrups of a Saxony sugar factory which actively fermented solutions of 50 per cent. concentration. It was named *S. Zopfii* after him.

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[1] According to JACOBSTHAL, however, 100 c.c. of water dissolves 26·85 mgrms. of $CaCO_3$; and a 15 per cent. sucrose solution, 23·5 mgrms.

[2] *Loc. cit.*

[3] German Patent, 318,654.

[4] *I.S.J.*, 1920, 237; also German Patent, 266,290.

Recently Dr. Satava was able to isolate from four different sugar products certain *Zygosaccharomyces* capable of fermenting saccharine media having a density of 55 to 60 per cent. of solids. One of these, named temporarily *Zygosaccharomyces K* fermented a clairce (*klarsel*) of 60° Brix so actively that the gas bubbles broke through the film of crystals that continually formed on the surface of the liquid. Another which was isolated from marmalade was called *Zygosaccharomyces M*; while a third found in a factory syrup was similarly named *Zygosaccharomyces S*. A study was made of the properties of these yeasts in comparison with *Zygosaccharomyces Barkeri*[5] and *Z. Priorianus*, the result of which was to show that organism *K* is very similar to Barker's *Zygosaccharomyces*; that *M* differs considerably morphologically; and that *S* shows many physiological differences. Nevertheless, the author hesitates to regard the three organisms as distinct varieties of *Zygosaccharomyces* until the matter has been investigated by others, preferring in the meantime to consider them as variations from the group of *Zygosaccharomyces Barkeri*[6]. Lastly some observations were made on the fermentation of solutions containing 40 to 65 per cent. of sucrose, to which asparagin, ammonium phosphate, potassium phosphate, and magnesium sulphate had been added, using *Z. Barkeri*, *Saccharomyces ellipsoideus*, *S. turbidans*, *S. cerevisiæ* and other yeasts as well as the three under consideration. Among the true yeasts examined only *S. ellipsoideus* was capable of fermenting a 55 per cent. solution; but all the four *Zygosaccharomyces* fermented the 40, 55, 60, and 65 per cent. solutions. One of the peculiar characteristics of the *Zygosaccharomyces* cultures is their tendency to remain floating at the surface of the solution; whereas all the true yeasts examined sank to the bottom. It would seem also that the *Zygosaccharomyces* invert concentrated sucrose solutions only slowly; and that, although there may be evidence of a rapid fermentation, the amount of alcohol actually produced is small compared with that formed under ordinary conditions when dilute liquors and true yeasts are employed. It is also worth noting that in the case of the test with *Zygosaccharomyces M* a very pleasant aroma and taste were imparted to the solutions, which (it is suggested) may very well be used as a means for improving the flavour of beet factory syrup, making it more suitable for edible purposes.

Application of the Genter "Thickener" to the Filtration of First Carbonatation Juice. *C. E. Chaffin. Sugar, 1920, 22, 76-80.*

By the "thickening" of a liquid containing insoluble matter is meant its separation into (1) a large volume of clear liquid, and (2) a thick mud or sludge in which all the solids are accumulated. One of the oldest thickening methods, at present practised universally in the cane industry, is subsiding of the limed and heated juice in suitable tanks, and the decantation of the more or less clear liquid, leaving the insoluble matter in the form of a concentrated mud for treatment in filter-presses. Some objections to the use of tanks in this connexion are that a large amount of juice is kept in process for a rather long time, that a large floor space is required, and that the separation of the clear liquor from the mud may not be complete.

A more rapid and efficient result is claimed by means of the Genter "thickener," the patent specification relating to which was recently published.[7] It has been designed to handle large volumes of liquid containing a small amount of insoluble matter, say 5 per cent. or less, so as to deliver clear liquor and a mud containing 20 to 60 per cent. of solids, which later may be passed through a vacuum filter. It effects the separation of the clear liquid through a series of cylindrical filter elements which are submerged in the liquid to be treated. As the clear liquid is forced through the filter element, the intercepted solids are flushed or pulsated from the outside of the filtering surface, and this alternating filtering impulse and discharge impulse results in keeping the filtering medium continually clean, the result of which is that the rate of filtration is reasonably rapid. It should be noted, however, that a mere counter-current of filtrate at substantially short intervals does not alone discharge the thin film of cake; and that the counter-current must be accompanied by a release of filtration pressure, otherwise the medium will be freed of a very small portion only of its solids.

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[1] "Garungsbakteriologisches Praktikum," Berlin, 1909, page 187.

[2] *Wochensch. f. Brauerei*, 1894, 153.

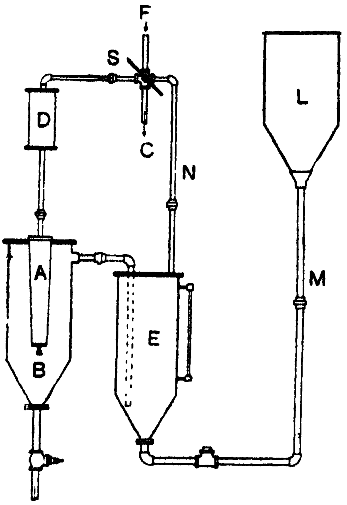
[3] *Revue de Viticulture*, 1897, 100.

[4] *Koch's Jahresb.*, 1907, 101.

[5] *Transactions of the Royal Society*, 1901, 194, 467.

[6] A *Zygosaccharomyces* found on dunder, Barbados sugar, figs and pears, has also been described by Holm.

[7] U.S. Patent, 1,269,700; *I.S.J.*, 1919, 627.



Turning to the diagrammatic sketch, one method of action using a series of impulses from a montejus, and alternating these impulses with a succeeding series of counter-current pulsations of shorter duration, is shown. At *L* is a gravity feed tank containing the liquid under treatment, which flows through the line *M* into the montejus *E*, forcing the air out of this vessel by way of the pipe *N* and the four-way valve, exhausting at *C*. During this time the handle *S* of the four-way valve is in the reverse position to that illustrated. As soon as the montejus *E* is full, the handle *S* of the four-way valve is switched (by automatic action) to the position shown, and compressed air at 20-30 lbs. enters *N* through the four-way valve. This forces unfiltered liquid into the thickening chamber *A*, closes a check valve, forces filtrate through element *B* into filtrate storage *D* by way of the four-way valve and out at *C*. As soon as the charge in the montejus is low enough, the four-way valve is again switched. This releases all pressure in the montejus, which in turn releases the pressure surrounding the exterior surface of element *B*, permitting during this period of release two things to happen : (1) the compressed air entering at *F* reverses its direction through the four-way valve, giving a counter-current impulse to the filtrate stored in *D*, and dislodging the accumulated solids on the exterior of element *B* ; and (2) the montejus is again filled by gravity from tank *L*. As soon as it is full, *S* is again switched, and thus the cycle of actions continues, first a filtration impulse, then a counter-current pulsation occurring simultaneously with the pressure release on the exterior of the filtering element. The discharged solids settle to the bottom of chamber *B*, and are withdrawn continuously and finally sent through a suitable vacuum filter. In practice the four way valve is switched automatically by means of a pilot air system actuated by two floats in the montjus.

Apparatus designed on this principle operated for the better part of two campaigns on first carbonatation juice at the Sterling factory, Colorado (belonging to the Great Western Sugar Co.), and is stated to have functioned perfectly. The juice fed to the thickener contained 2 to 3 per cent. of solids, and the mud discharged contained from 17 to 27 per cent. of solids. The rate of filtration of the first carbonatation juice at a temperature of 90° C., using a pressure of 20 to 30 lbs. per sq. in. averaged 0·5 gall. per min. per sq. ft. of canvas filter medium. The thickened discharge or mud was fed to a continuous vacuum filter, operating at 8 revolutions per hour, giving a cake averaging 0·5 in. thickness containing 0·6 to 0·7 per cent. of sugar (of which 0·2 per cent. was "free"). An ordinary pressure-filter installation in a 1000-ton house means 4000 to 6000 sq. ft. of cloth for the first carbonatation juice, and 4 to 7 men per shift; whereas with the Genter apparatus the canvas area would be 1100 to 1200 for both thickener and vacuum filter, and one man would be sufficient to oversee the entire installation, which is stated to be positive, continuous, automatic, and "fool-proof."

HOT SULPHITATION OF LIMED CANE JUICES. *W. H. Th. Harloff. La. Planter, 1920, 64, No. 1, 14.*

If a raw cane juice be sulphited and limed, or first limed and then sulphited (as was formerly done in Java), and if the clear juice obtained after the filtration of the precipitate thus formed be heated to 50-60°C., a second precipitate will be produced, composed almost entirely of calcium sulphite. Its formation is due to the fact that calcium sulphite is less soluble at higher than at lower temperatures. It is not quite white, being greyish or brownish, and it is worth noting that during the precipitation certain colloidal organic bodies are carried down by it, while also a double compound with the inorganic matter in solution (potassium and calcium salts) may be formed. It is known that the more copious the precipitate in clarifying juices by the sulphitation or the carbonatation process, and the more rapid its formation, the greater the amount of absorbed impurities. In beet factories, therefore, the juice is thoroughly heated before liming, and the content of carbon dioxide in the gas used for saturation is always kept as high as possible.

In the cane sugar factory it is, of course, not possible to lime the heated juice previous to sulphiting, owing to the formation of glucose decomposition products; nor is it economically possible to sulphite the heated juice, previous to liming. There is, however, an alternative, and that is to carry on sulphitation and liming simultaneously at a high temperature without danger of the formation of coloured bodies and with a good clarifying effect. In Java the hot defecation-sulphitation process is operated in the following way at the present time: Cold raw juice from the mills is pumped through heaters to raise it to 80-85°C., and discharged into the sulphitation tanks. The sulphurous acid gas inlet is opened, this being done to such an extent that the inflowing gas thoroughly mixes the contents of the vessel. Immediately the milk-of-lime is allowed to run in at such a rate that the reaction of the liquid is substantially neutral, this being controlled by frequent tests made with neutral phenolphthalein paper. If the glucose content of the juice is rather high, it is well to allow the reaction to remain slightly acid; but if the juice is rather viscous it is preferable to maintain it slightly alkaline. At the end of the operation the reaction is always brought to neutrality, as is the case in the ordinary cold sulphitation process. Saturation being completed, the muddy juice is pumped through heaters to boiling point, and finally allowed to subside. Whereas in the cold sulphitation process, considerable trouble is experienced by the deposition of calcium sulphite in the tubes of the heaters, this no longer happens to anything like the same extent when following the new procedure. Another important advantage of the process is that not only is subsiding more rapid, but the clear juice obtained is lighter in colour than formerly, while also the subsequent working of the products is much facilitated.

REDUCING THE COST OF CANE CULTIVATION BY MULCHING. *Charles F. Eckart. La. Planter, 1919, 63, No. 25, 395.*

It is stated that the mulching process, using paper made locally from bagasse, is proving very economical in labour, while also increasing the yield of the cane.[1] One man engaged in weeding can get over the same amount of ground in 20 days which otherwise requires 33 days. Using a mulch 36 in. diam., 2·26 men are able to hoe an acre in the time that it takes 7·62 men to deal with the same area of unmulched land. Since the mulching paper keeps the rows free of grass and similar growth, it is only necessary at Olaa, T. H. (where the process has been under trial) to keep the "hono-hono" (a species of small grass) in check by cultivating or spraying.

J. P. O.

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[1] *I.S.J.*, 1917, 455; 1918, 434, 567; 1919, 626.

Review of Recent Patents.[1]

UNITED STATES.

APPARATUS FOR REGULATING THE SUPPLY OF MACERATION WATER TO THE MILL.[2] *August Kruse*, of Waimea, Kauai, T. H. *1,331,016.* Date filed, April 18th, 1919; patented, February 17th, 1920. (Four figures.)

It is the purpose of the invention to regulate the amount of maceration water supplied to the bagasse in accordance with the thickness of the blanket, this control being effected by the relative movement of the top roll due to the thickness of the mass passing through the mill. Interpolated in the supply pipe *3* is a regulating valve *4* which may be of any suitable or convenient type, the stem of which is connected by a coupling *5* to the end of a lever *6*, which is pivoted intermediate its ends on a suitable bearing *10*. It is provided at its other end with a shoe *7*, connected to the lever end by a pivot joint *8*, this shoe engaging the under face of the end of the shaft or journal *2* of the top roll of the mill.

Fig. 1.

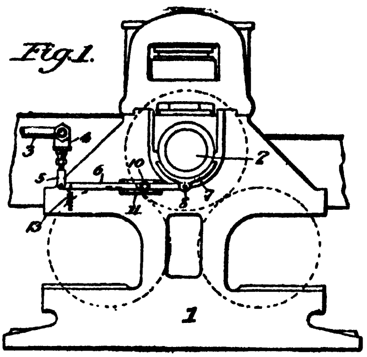


Fig. 2.

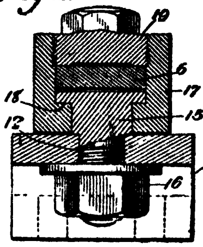


Fig. 3.

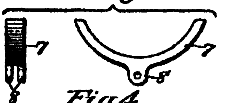
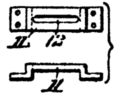


Fig. 4.



In order to maintain the shoe *7* in contact with the journal *2* and cause the same to follow the movements of the top roll, a spring *13* or similar power-applying device is connected to the valve end of the lever *6*. So as to adapt the mechanism to mills of various types and sizes, and to regulate the extent of movement of the lever and the opening and closing movements of the regulating valve *4*, a special form of pivot mounting for the lever is provided, consisting of a bracket *11* secured to the mill housing equipped with a longitudinal slot *12*, which receives a locking bolt *15* secured to the bracket by a nut *16*. This bolt has a flanged head *18* which engages the interior of an annular collar *17* having a transverse slot through which the lever *6* passes, this collar carrying a screw-threaded plug *19* which clamps the lever *6* in position. This construction of pivotal support admits of the collar *17* pivoting on the stud member *15* to accommodate the rocking motion imparted to the lever *6*. By adjusting the stud *15* longitudinally of the slot *12* in the bracket 11, the lengths of the respective arms of the lever *6* may be varied and a corresponding variation in the movement of the valve *4* by the lever produced.

When the mill is in operation, the top roll of the set is raised and lowered in accordance with the thickness of the blanket of bagasse passing through the mill and as the roll rises and falls, the shoe *7* connected to lever *6* will partake of this movement and rock lever *6* to a corresponding extent, thereby moving valve *4* commensurately, so that the supply of maceration fluid through the pipe *3* will be regulated in exact accordance with the movement of the top roller and therefore in correspondence with the quantity of bagasse passing to the mill. To regulate the maximum amount of maceration fluid supplied, which may be readily determined by a skilled mill operative, the pivotal point of the lever *6* is adjusted by means of the bearing *10* by slacking off the nut *16* and sliding the stud *15* in the slot *12* of bracket *11* and when the proper adjustment has been effected, setting up the nut *16* to clamp the stud *15* in position.

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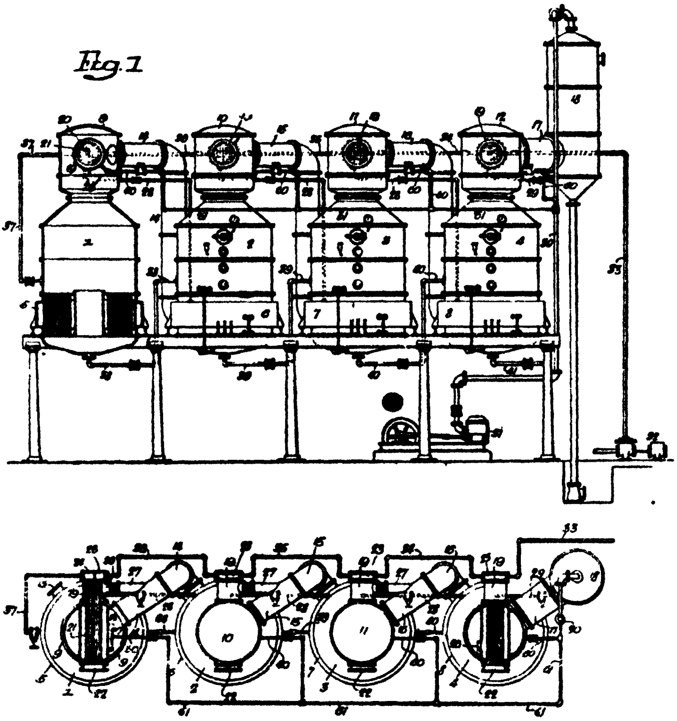
[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States:* Commissioner of Patents, Washington, D C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 2 fr. 00 each).

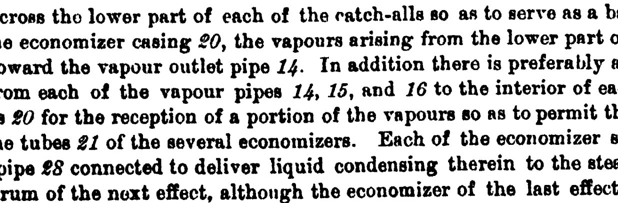
[2] See also *I.S.J.*, 1920, 269.

MULTIPLE EFFECT EVAPORATOR, PROVIDED WITH ECONOMIZERS IN THE SAVE-ALLS. *Ezra A. Newhall*, of Philadelphia, Pa., U.S. *1,318,793*. Date of filing, May 9th, 1917; patented, October 14th, 1919. (Six figures.)

A method is described for utilizing the latent heat of the vapours of a multiple effect apparatus so as to provide the sensible heat necessary to raise the temperature of the juice prior to its introduction to the compartments. Referring to the drawings, it is seen that in each of the four catch-alls, *9–12*, is mounted an economizer *19* consisting of a horizontally extended and preferably cylindrical shell *20* extending at one end outside of the evaporator and having tube sheets in which are mounted the ends of a series of tubes *21*. These latter at one end all connect with a chamber *22* and at the opposite end part of them connect with a chamber *23* and the other part with a chamber *24*. A partition *25* extends across the lower part of each of the catch-alls so as to serve as a baffle and deflect around the economizer casing *20*, the vapours arising from the lower part of the effect and flowing toward the vapour outlet pipe *14*. In addition there is preferably a valved branch pipe *27* from each of the vapour pipes *14*, *15*, and *16* to the interior of each of the shells or casings *20* for the reception of a portion of the vapours so as to permit these to circulate around the tubes *21* of the several economizers. Each of the economizer shells or casings *20* has a pipe *28* connected to deliver liquid condensing therein to the steam space of the heating drum of the next effect, although the economizer of the last effect has its casing connected through a pipe *29* to the vapour-receiving space of the condenser *18*.

Fig. 1





In that form of the invention shown in the drawings, the liquor to be evaporated is delivered by a pump *32* through a pipe *33* to the chamber *23* of the economizer of the fourth effect, and the second or outlet chamber *24* is connected by a pipe *34* to the receiving chamber of the economizer of the effect *3*. Likewise the liquid space of the economizer of the effect *3* is connected by a pipe *35* with the economizer of the effect *2*, the latter in turn being connected by a pipe *36* with the economizer of the effect *1* and having its second chamber *24* connected through a pipe *37* to deliver liquid into the liquid-receiving space of the first effect *1*. The lowest portion of the first effect is connected through a pipe *38* with the liquid-receiving space of the second effect *2* and the lowest part of the latter is connected through a pipe *39* with the liquid-receiving space of the effect *3*, whose lowest portion is connected by a pipe *40* to the liquid-receiving space of the effect *4*. The lowest part of the latter has connected to it a pipe *41* whereby the concentrated liquor may be delivered to any desired apparatus or storage receptacle. To each economizer an air pipe *60* through a main *61*, is connected to the suction pipe *30* of the air pump *31*; thereby keeping the economizers free of air and non-condensible gases.

As a result of this method of procedure, the relatively cold liquor passes successively through the economizers of the 4th, 3rd, 2nd, and 1st effects, so that its temperature is successively increased until it finally flows into the liquid-boiling space of the first effect at a temperature but little below that required to cause it to boil, a portion of the latent heat of the vapour flowing from the effect in which any particular economizer is mounted being converted into sensible heat which increases the temperature of the liquor. It is claimed that the capacity of the apparatus is increased, since the economizers provide additional heating surface, and vapours condensed in them must be replaced by additional evaporation in their respective effects in order to evaporate the required volume in the next succeeding effect. Moreover, there is a material reduction in the amount of heat required for the evaporation of a given body of liquid, this being due partly to the prevention of heat radiation owing to the mounting of the economizers within the casings of the effects and partly to the efficient utilization of the heat of the vapours to successively raise the temperature of the liquid to be evaporated or concentrated. While the arrangement of piping and apparatus shown will give good results for certain purposes, under certain conditions economizers may be provided in certain only of the effects, and in the original specification several different arrangements of apparatus and piping are described.

BEET HARVESTERS. (1) *James A. Caywood*, of Nederland, Colo., U.S.A. *1,336,024*. Date of filing, December 5th, 1918; patented, April 6th, 1920. (2) *Charles Nelson and Lewis A. Coffeen*, of Denver, Colo., U.S.A. *1,336,313*. Date of filing, December 28th, 1918; patented, April 6th, 1920.

BEET TOPPER. *Morgan A. Greene*, of Rupert, Idaho, U.S.A. *1,335,962*. Date of filing, September 17th, 1918; patented, April 6th, 1920.

BEET SCREENING, PILING, AND LOADING MACHINE *Frank Jones*, of Salt Lake City, Utah, U.S.A. *1,336,297*. Date of filing, August 19th, 1919; patented, April 6th, 1920.

CENTRIFUGALS. *Angus H. Gibson*. *1,336,779*. Date of filing, April 21st, 1915; patented, April 13th, 1920.

ATTACHMENT FOR COLLECTING MOLASSES FROM CENTRIFUGALS. *John N. S. Williams*, of Honolulu, T.H. *1,304,840*. Date of filing, December 6th, 1917; patented, May 27th, 1919. (Four figures.)

An attachment is described for the collection of molasses from the centrifugal while the basket is in operation, capable of being mounted on machines of existing type. It consists of a pivoted channelled member extending into the basket, the mouth of which is placed in the opposite direction to that in which the basket revolves. It may be swung into or out of position as required; and means are provided for varying the distance between the mouth of the channel and the wall of the basket. Referring to figures 2 (vertical sectional view) and 4 (horizontal sectional view), it is seen that a pair of brackets *7* are secured to the top of the casing by bolts *8*. Extending between the corresponding ends of these brackets is a bolt *9*, on which pivotally mounted is a bridge member *10* provided with a pair of horizonally extending arms *11*, which are arranged to swing between the brackets *7*. On the opposite ends of the brackets *7*, clips *12* are mounted on bolts, which serve also to secure the brackets to the casing. These clips are maintained in their operative positions by winged-nuts *14*. When these nuts are loosened, the clips are permitted to swing out of the path of movement of the arms *11*, and consequently permit the movement of the bridge member.

Fig. 2.

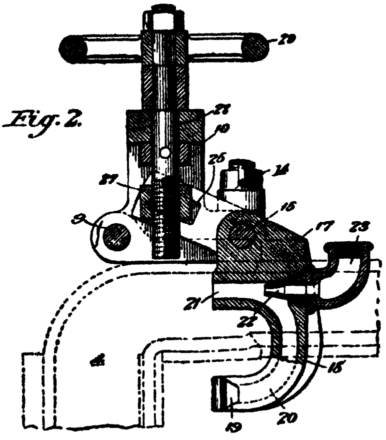
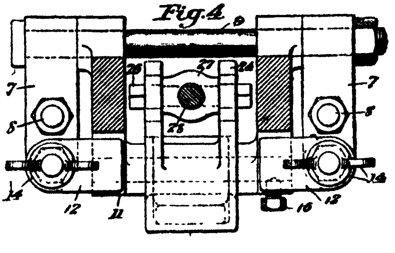


Fig. 4.



A journal *15* extends between the arms *11* and is held stationary by a tap-bolt *16*, on which journal a gathering and discharging element *17* is mounted for swinging movement. This element *17* includes a channelled member *18*, which extends downwardly toward the peripheral wall of the basket; it curves in a direction substantially concentric with the basket and opposite to that of the rotation of the basket. The end of this member *18* is provided with an opening or mouth *19* into which the material to be gathered is forced during the movement of the basket. A channel *20* extends upwardly from this mouth *19* and opens at *21* into the annular space *4* between the wall of the basket and the adjacent wall of the casing, so that the molasses will pass through the channel and will be discharged into a gutter and thence out of the machine. Passage through the channel *20* is greatly enhanced because of the presence of the ejector *22*, which projects into the channel *20* in alignment with the opening *21*, provided with supply means *23*, by which steam is supplied.

In order that the mouth *19* may be swung so as to be located a greater or lesser distance from the imperforate wall, there extends from the element *17* a pair of arms *24* in which elongated openings or slots *25* are formed. Trunnions *26*, extending from the ends of a yoke-member *27*, are located within these openings. A vertical spindle *28* extends through and has screw-threaded engagement with the yoke *27*, and is mounted in suitable bearings carried by the bridge member *10*. The upper end of this spindle is provided with a hand-wheel *29*, so that the spindle may be rotated and during the rotation will either raise or lower the yoke *27*, and consequently swing the element *17* about its pivot and cause the mouth *19* to move with relation to the wall of the revolving basket

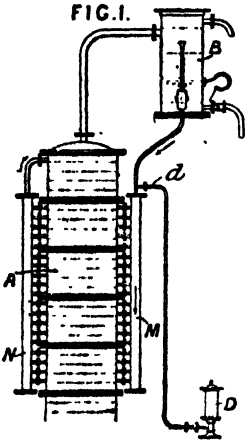
In operation, after the basket has revolved for a sufficient length of time to permit the materials to properly arrange themselves, the element *17* is swung into the basket so that the mouth *19* of the channel *20* will project into the material which is to be gathered and discharged. As the separating basket revolves at a comparatively high rate of speed, the material is forced into the mouth *19* and upwardly through the channel *20*. The jet of steam passing through the upper end of this passage-way dilutes the molasses, and also forces the material from the passage-way into the space *4*. After all the molasses has been gathered and discharged, the device may be swung about the bolt *9* as a pivot to permit the collection of the sugar crystals from the separating basket.

UNITED KINGDOM.

Apparatus for Rectifying Alcohol. *Barbet et Fils et Cie.*, of Paris. *138,869* (*3707*). Date of application, February 8th, 1919; *not yet accepted.*

As is shown in the figure, the vapours from a rectifying column *A* are led to a single tubular condenser *B* instead of the separate condenser and cooler hitherto used. The condensate formed in the condenser *B* is divided into two parts, one serving as a reflux in the rectifier *A*, and the other constituting the distillate. The reflux portion is heated by heat exchange with the fluids in the rectifier before it is led on to the upper trays of the rectifier. In rectifying alcohol, the heating of the reflux is effected by passing it from a header *M* through coils immersed in the liquid on the trays, and the heated reflux is collected by a header *N* and led to the top of the column. The remainder of the condensate flows through a valved pipe *d* to the test-glass *D*. In other cases, the heat exchange is effected in a single tubular apparatus in the top of the rectifier. Cooling-water is supplied to the condenser *B*, it may be, under thermostatic control, in such quantities as to prevent the formation of incrustation; in the rectification of toluol, xylol, petroleum, etc., boiling of the water is entirely suppressed. The rectifying plant may be continuous or discontinuous, and may be arranged for "pasteurization" of the distillates.

FIG. I.



Preparation of Decolorizing Carbon, and of a Decolorizing Phosphoric Clarifier for Juices and Syrups. *C. S. Hudson*, of New Jersey, U.S.A. *139,156*, (*1846*). Date of application, January 20th, 1920; *not yet accepted.*

A decolorizing carbon is prepared by heating to a temperature preferably above 375° C. a mixture of organic material and a fusible acid (such as phosphoric or boric acid, which will not boil or will not decompose in the presence of carbonaceous material at a temperature of 375° C.). Suitable organic materials are sawdust, corn cobs, or scrap leather, or even decolorizing carbon to be revivified; and, in the process of carbonization, it is preferred to raise the temperature to between 400° and 600° C. The proportion of acid has an effect on the power of the finished product; a carbon of satisfactory power is obtained if the proportion is one-half part of acid to one part of organic material; but a carbon of much greater activity is obtained if the proportion is increased to two parts of acid to one part of organic matter. The acid that remains in the charred product may be removed by leaching, and it may then be re-used in the carbonization process. In some cases, complete removal of the acid is necessary, for example if boric acid has been added and the carbon is to be used for treating articles of food; but in other cases complete removal is not necessary and the acid that remains is either innocuous, or may assist in the purifying process, as is the case if phosphoric acid has been used and the carbon is to be employed in clarifying juices and syrups in the factory and refinery. For the latter purpose, it may be convenient for handling and transport not to attempt any separation of the carbon and metaphosphoric acid, since the charred product is a dry granular powder more easily handled than the acid alone.

Machine for Wrapping Caramels, Sweatmeats, Etc. *Francis Heath*, of Deighton, Huddersfield. *139,610* (*5097*). Date of application, March 1st, 1919; complete accepted, March 11th, 1920. (Nineteen figures.)

Cutting Machinery for Marmalade Manufacture. *Frank G. Blott and Horace Friend*, of Wisbech, Cambridgeshire. *139,653* (*8554*). Date of application, April 4th, 1919; complete accepted, March 11th, 1920. (Four figures.)

COATING CONFECTIONERY, AS CHOCOLATE. *Luis Wirtz*, of Great Marlborough Street, London. *139,256* (*1135.*) Date of application, January 16th, 1919; complete accepted, March 4th, 1920.

Chocolates or other sweets, particularly those of a soft and sticky nature, are provided with an edible cover or sheath by coating with a solution of gum arabic, gelatin or other suitable substance which will get hard on drying or cooling. The coating liquid may be mixed with powdered chocolate with or without flavouring substances.

COOLING CHAMBERS FOR CHOCOLATE, ETC. *Fours et Procédés Mathy*, of Liège. *139,383* (*14,442*). Date of application June 6th, 1919; complete accepted, March 4th, 1920. (Six figures.)

APPARATUS FOR GRINDING CACAO, CHOCOLATE, ETC. *Carl Postranecky*, of Dresden, Germany. *13,512*. Date of application, June 3rd, 1914; complete accepted, May 8th, 1920.

MACHINES FOR COATING CHOCOLATE BONBONS. *A. Sonsthagen*, of West Ealing, London. *142,259* (*8395*). Date of application, April 3rd, 1919; complete accepted, May 6th, 1920.

EFFECTING CRYSTALLIZATION FROM SOLUTION. *Norsk Hydro-Elektrisk Kvaelstofaktieselskab*. *134,207* (*25,018*). Date of application, October 23rd, 1918; complete accepted, May 6th, 1920.

MANUFACTURE OF SUGAR AND FURFURAL FROM WOOD, ETC. *A. Classen*. *142,480* (*11,691*). Date of application, March 18th, 1919; *not yet accepted.*

UNITED KINGDOM COMPLETE SPECIFICATIONS ACCEPTED.[1]

CENTRIFUGALS. (1) *De Laval Separator Co.* *142,860* (*12,631*). August 31st, 1917. (2) *W. McChesney*. *142,949* (*4367*). February 21st, 1919.

PRODUCTION OF ALCOHOL. *E. C. Bayer and S. Orla-Jensen*. *119,030* (*14,046*). May 14th, 1919.

DISTILLING APPARATUS. *J. H. Zaeckel*. *143,428* (*17,796*). July 16th. 1919.

UTILIZATION OF CARBOHYDRATE IN PLANTS AND WASTES. *Soc. Darrasse Frères and L. Dupont*. *123,326* (*3509*). February 13th, 1918.

OBTAINING GLUCOSE FROM WOOD. *H. Terrisse and M. Levy*. *143,212* (*12,609*). May 13th, 1919.

COATING CONFECTIONS. *G. R. Baker*. *142,935* (*3686*). February 14th, 1919.

ROASTING COCOA BEANS. *M. Pannevis*. *143,224* (*12,956*). February 1st, 1919.

CENTRES FOR CONFECTIONERY. *C. W. Taussig* (*J. P. Booker*). *143,314* (*4175*). February 19th, 1919.

STOVE FOR CONFECTIONERS. *J. M. and T. F. Murray and J. G. Steven*. *143,424* (*17,292*). July 10th, 1919.

LIQUID FUEL. *E. C. R. Marks* (*U.S. Industrial Alcohol Co.*) *143,017* (*11,178*). May 5th, 1919.

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[1] The date given is that of application.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1920. Tons.	1919. Tons.
Total Receipts January 1st to May 27th	1,352,584	1,320,789
Deliveries ,, ,,	1,352,584	1,316,789
Meltings by Refiners ,, ,,	1,321,000	1,187,000
Exports of Refined ,, ,,	220,000	155,000
Importers' Stocks, May 27th	—	4,000
Total Stocks, May 27th	42,016	145,279
	1919.	1918.
Total Consumption for twelve months	4,067,671	3,495,606

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1917-1918, 1918-1919, AND 1919-1920.

(Tons of 2,240 lbs.)	1917-18 Tons.	1918-19. Tons.	1919-20. Tons.
Exports	1,133,222	1,302,952	1,897,207
Stocks	1,042,422	1,097,753	672,948
	2,175,644	2,400,705	2,570,155
Local Consumption	44,400	38,000	32,500
Receipts at Ports to April 30th	2,220,044	2,438,705	2,602,655

Havana, April 30th, 1920 J. GUMA.—L. MEJER.

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR FIVE MONTHS ENDING MAY 31st, 1913, 1919, 1920.

	IMPORTS.			EXPORTS (Foreign).		
	1913. Tons.	1919. Tons.	1920. Tons.	1913. Tons.	1919. Tons.	1920 Tons.
Refined	346,400	167,790	91,573	456	187	761
Raw	426,643	491,093	588,352	1,391	5,699	1,242
Molasses	65,635	53,440	38,639	160	135	1,303
	838,678	712,323	718,564	2,007	6,021	3,306

	HOME CONSUMPTION.		
	1913. Tons.	1919. Tons.	1920. Tons.
Refined	336,579	144,067	101,193
Refined (in Bond) in the United Kingdom	295,003	339,495	301,364
Raw	47,845	134,799	123,621
Molasses	12,862	23,678	16,687
Molasses, manufactured (in Bond) in United Kingdom	16,724	30,788	33,858
Total	709,013	672,827	576,723
Less Exports of British Refined	10,686	428	117
	698,327	672,399	576,606

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

	One Month ending May 31st.		Five Months ending May 31st.	
	1919. Tons.	1920. Tons.	1919. Tons.	1920. Tons.
UNREFINED SUGARS.				
Russia	....	....	....	.
Germany	....	850	....	5,680
Netherlands	....	....	1	....
Belgium	....	....	....	....
France	....	....	....	....
Austria-Hungary	....	....	..	....
Java	14,945	....	87,053	162
Philippine Islands	....	....	....	....
Cuba	77,280	141,453	241,973	383,821
Dutch Guiana	....	31	961	31
Hayti and San Domingo	....	....	....	....
Mexico	....	....	....	....
Peru	3,784	2,271	22,374	20,462
Brazil	2,086	68	2,416	5,848
Mauritius	10,598	11	94,232	95,418
British India	....	4,050	....	7,076
Straits Settlements	....	....	....	....
British West Indies, British Guiana & British Honduras	23,760	18,670	39,390	55,510
Other Countries	1,369	2,548	2,694	14,344
Total Raw Sugars	**133,823**	**169,952**	**491,093**	**588,352**
REFINED SUGARS.				
Russia	....	....	....	....
Germany	....	....	....	126
Netherlands	....	49	....	1,055
Belgium	309	393	309	1,105
France	1	1	18	3
Austria-Hungary	....	97	....	116
Java	16,825	2	48,881	7,423
United States of America	34,217	10,138	94,758	74,570
Argentine Republic	1	4	7	12
Mauritius	6,745	....	12,655	....
Other Countries	10,311	165	11,162	7,163
Total Refined Sugars	**68,409**	**10,849**	**167,790**	**91,573**
Molasses	11,301	2,833	53,440	38,639
Total Imports	**213,533**	**183,634**	**712,323**	**718,564**

EXPORTS.

	Tons.	Tons	Tons.	Tons.
BRITISH REFINED SUGARS.				
Denmark	....	....	....	....
Netherlands	....	....	....	2
Portugal, Azores, and Madeira	....	....	....	....
Italy	....	....	....	....
Canada	....	....	....	....
Other Countries	113	17	428	115
	113	17	428	117
FOREIGN & COLONIAL SUGARS.				
Refined and Candy	55	106	187	761
Unrefined	4,049	6	5,699	1,242
Various Mixed in Bond	91	42	135	1,303
Molasses	....	....	....	....
Total Exports	**4,308**	**171**	**6,449**	**3,423**

Weights calculated to the nearest ton.

Sugar Market Report.

Our last Report was dated 7th May, 1920.

As from the 17th ulto, the Royal Commission on the Sugar Supply advanced the price of Granulated, Crushed and White Pieces for domestic consumption to 112s. per cwt. (retail price 1/2 per lb.), and that for Government allotments to all manufacturers to 160s. The latter figure was also fixed as the maximum reasonable price for "free" sugar on the spot. Such small remnants of fine white descriptions as were available, commanded the full limit. The market is being rapidly cleared of West India crystallized at advancing prices, up to 154s. having been paid for best qualities. For Syrups and Muscovados the enquiry remains comparatively limited. Whilst the recent advance has established values for supplies to manufacturers on the full parity of World's prices, the public continue to benefit, as far as domestic consumption is concerned, by the advantageous purchases of the Royal Commission, which still permit of a concession in regard to household supplies.

A strong advance, which carried Cuban Centrifugals to 23 cents per lb. f.o.b., followed the publication of reduced estimates by Messrs. Guma & Mejer and Mr. Himeley of 3,650,000 tons and 3,700,000 tons respectively. Concurrently with the demand for Cubans from American refiners, further considerable purchases of White Javas (mainly, it is believed, for account of manufacturers) were effected for early shipment ex stocks lying in China, Japan and India, at prices ranging up to 23 cents per lb. (about 134s. per cwt.) c.i.f. Total sales of this description (including direct shipment from Java) to American destinations are now estimated at 300/350,000 tons. It is impossible to say how much of this sugar remains in the hands of speculators, but there is no doubt that the American public strongly suspected that a speculative element, outside the ordinary trade, was largely responsible for the high prices reached, and a nervous feeling in the New York market was caused by fears of drastic remedial Government measures in deference to popular agitation. This was reflected in a sharp decline, under which the Cuban quotation fell to the neighbourhood of 18 cents, but the inherently strong position of sugar operated to arrest the fall, and prices have since reacted to about 19½ cents f.o.b.

The sanguine estimates of American consumption for this year, some of them as high as 5,000,000 tons, have certainly been largely responsible for the scramble for sugar seen on that side. A careful study of the statistical outlook, however, fails to indicate whence sufficient supplies are to be obtained to provide for a consumption of this magnitude. Upon the restricted basis of consumption in force in the United Kingdom, it is probable that the purchases already made by the Royal Commission, together with the arrivals of West India and low sugars, more or less provide for the needs of this country; European enquiry for the moment being dormant, America remains the key to the situation, so that, with the position as it is, any fresh effort on her part to secure supplies must apparently result in a stiffening of prices.

The Java market has been largely under the influence of American movements, and prices have fluctuated in sympathy. At the firmest moment up to 75·00 guilders per picul was paid for Whites for June shipment; after a sharp reaction to about 56·00 for Autumn shipments, present quotations stand approximately as follows:—June 70·00, July 69·00 August 68·00, September 67·00, October 67·00 f.o.b. The new crop which commenced last month is estimated at 1,500,000 tons, of which about 150,000 will be required for home consumption, leaving about 1,350,000 tons available for export. No official figures are obtainable, but it is believed that the Royal Commission has secured some 450,000 tons and America say 200,000 tons. It will be seen that the balance of the crop is already earmarked when it is considered that India is estimated to require 250,000 tons, China and the Straits 300,000, Japan 100,000, Europe (outside of the United Kingdom) 50,000 tons.

The Factory Estimates of European Beet sowings are very much in accordance with Mr. Licht's predictions. The estimate for Germany is rather above recent anticipations, but the improvement in the German Exchange does not encourage hopes of exports from that country.

H. H. Hancock & Co.

10 & 11, Mincing Lane,
London, E.C. 3,
6th June, 1920.

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

Notes and Comments.

The *Mauritius* Sugar Crop, 1920-21.

The Royal Commission on the Sugar Supply has secured the bulk of the coming Mauritius sugar crop for the United Kingdom, but at a much higher price per ton than was the case last year. Then, they secured the bulk also of the crop at an average f.o.b. price of £50 per ton, but now the 200,000 tons which they expect to obtain will cost from £89 to £91 per ton f.o.b. according to quality. This is a big jump in prices, but is not excessive, having regard to the world's ruling price this year, and it is stated that it should allow the sugar to be retailed to the public at a price of 1s. 3d. per lb. In view of the fact that the Mauritius sugar is of semi-refined quality, and that it will secure a preference in the Customs duty of £4 per ton, the figure of £90 does not compare unfavourably with the price being asked for Cuban sugar for the early months of next year, viz., 18 cents per lb. f.o.b. Cuba, or, at the present rate of exchange, say, £86 per ton. It is, at any rate, lower than the figure for which the Mauritius planters at first held out, viz., £100 per ton.

The World's Sugar Shortage.

Some of our press organs, including one financial paper, have criticized this purchase as a gamble which the autumn will prove unwarranted; but it may be assumed that the Royal Commission with their expert buyers did not offer more than was necessary to secure this crop at the expense of other competitors. These critics base their arguments mainly on the assumption that there is no real shortage of sugar in the world; whereas the plain fact is there is a very considerable shortage. The 1919-20 world's crop barely touches 15¼ million tons as compared with almost 18¾ millions in 1913-14. Even here, however, the difference between the two crops does not accurately represent the shortage since no allowance is made for increased demand for sugar with increase in population and increase in the sugar consuming habit, which, especially in the East, has been growing steadily the last decade. If we allow the very moderate figure of 3 per cent. increase per annum, we should arrive at a total of almost 22½ million tons as the world's normal consumption at the present time were the sugar available at a reasonable price. But the sugar is not available to more than the extent of two-thirds, so the world will continue for two or three years more to scramble for the available supplies at high prices, and if we do not bid high enough, we in this country will continue to go short. For the present the Royal Commission has set itself the task to secure enough sugar at the current high prices to allow the present restricted domestic ration of 26 lbs. per head per annum *plus* a likewise restricted ration for the sugar-using trades—in all, some 1,100,000 tons per annum, and declines to bid for larger quantities with the almost certain consequence of higher prices.

Unfortunately, there is not much hope of any rapid increase in the world's cane sugar output during the years of greatest stress. Cane regions, subject to weather conditions, are producing very much their maximum outputs, and extensions of both planted areas and manufacturing capacities cannot, as is well known, be executed in a season or even two; the delay in the manufacture at home of factory plant, which is the consequence of the repeated strikes and other manifestations of labour unrest, must reflect itself in corresponding delay in the sugar colonies, and of course in the end the workman at home, the consumer, will suffer by having to continue paying heavily for his modicum of sugar.

Cane being restricted by the capacity of its existing plant can only expand slowly. Beet, on the other hand, has the plant largely in existence (though reports are not wanting that as regards German factories, some of them suffer from having been stripped during the war of valuable copper and brasswork; one hesitates, however, to believe that this was anything like a common practice); and it is to beet that the world will undoubtedly look for the earliest means to relieve the present stringency. Unfortunately, though it is the case that the tide of output has turned on the Continent and henceforward we may look for an annual increase in the European beet sugar production, there is no ground for counting on any very rapid reversion to pre-war figures of output. In 1913-14 the European beet sugar production was somewhat under 8¼ million tons, while during the coming season it is estimated at little over 3¾ million tons, a shortage of some 4½ million tons as compared with 1913-14, but an increase as compared with 1919-20 of barely three-quarters of a million tons. Germany's share of the increase is, according to LICHT, put at 420,000 tons, but a more cautious estimate in our June issue indicates the increase as only 260,000 tons. In either case, the new crop is a long way behind the figure of 2,630,000 tons for 1912-13 and 2,715,900 tons in 1913-14. How quickly the German—indeed, the whole European—beet sugar production will revive is largely a question of how soon political and economic conditions will allow industry to settle down to steady work, and not only re-condition the sugar factories, but also revive the exhausted and neglected soil. It is at any rate clear, that though there will be a steady expansion in coming years of the beet sugar production, it will not be sufficiently expedited as to relieve the present severe shortage for two or three years longer.

More Lead from the Government.

In view of this shortage, it is perhaps relevant to ask whether all is being done by the Government that might be to increase the production within the Empire of this food. The authorities have recognized the shortage in the negative sense by refusing to allow the country to run further into debt through competing for an unlimited amount of sugar; rationing is in force and the country has to be content with rather less than half the sugar it could normally consume. But what are the Government doing in a positive sense to relieve the stringency? At home they have given their benediction and their financial assistance to a solitary experimental sugar factory that will commence to turn out sugar 15 months hence; but the high price of sugar that is bound to rule for some years to come would surely warrant the early erection of half a dozen factories at the very least. They could not help paying their way with sugar at the present price coupled with the differential duty in favour of home grown sugar, unless grossly mismanaged. But a policy of extreme caution is being favoured. The result will be that by the time the Kelham factory has demonstrated its success, and duplicate ventures can be set to work, the profits will be less abundant for wiping out the capital cost owing to the stringency in the sugar supply not being so marked.

Then abroad, in the cane sugar colonies and dependencies the most pressing need in those places where there is room for adequate expansion is a good labour supply. In the West Indies, outside Jamaica (which can expand to say 200,000 tons) British Guiana is the only region that, given facilities, can extend its area of cane very largely. But here the labour supply—or rather the lack of it—is a serious difficulty, and while we are far from suggesting that the most has been made of the existing supply, or the most approved practice of sugar manufacture has been adopted, yet it is undoubtedly the case that successful expansion can only be got if a further influx of coloured labour is obtained. We understand that a deputation from the colony has lately been visiting India and making representations to the Indian Government to allow once more—doubtless under more equitable conditions—the emigration to British Guiana of Indian workers. It is to be hoped that the India Office at home will do its best to plead the cause of the colonies and enable some arrangement to be arrived at satisfactory to both parties. Apart from labour, there is a need of more capital being diverted to the sugar colonies to extend the industry; but capital seems yet undecided as to whether the Government intends to secure for investors a permanent safeguard against unfair conditions in the sugar market such as ruled in the bounty days and led to the wholesale ruin of West Indian sugar properties. The Government ought at an early date to re-state definitely its proposed anti-bounty legislation and stimulate capital to go and invest in the sugar industry. Then there would be more prospect of an increased sugar supply within the British Empire.

World Production of Beet and Cane Sugar.

In a recent addition to Mr. TRUMAN G. PALMER's well known Loose Leaf Service "Concerning Sugar"[1] are some interesting figures dealing with the proportions of cane and beet sugar yields of the world. Since the 1911-12 season cane has consistently exceeded 50 per cent. of the world's supply, though in 1912-13 its percentage was no more than 50·7 per cent. In 1913-14 it was 52·6 per cent., and in subsequent years it rose to 55·5, 64·5, 66·1, 71·2, 73·2, and (in 1919-20 as estimated by WILLETT & GRAY) to 77·0 per cent., the supply of beet thus dropping to 23·0 per cent. of the world's sugar total. These figures demonstrate convincingly the great ascendancy the war has given to cane sugar at the expense of its rival. It is not without some satisfaction to observe that the country which was the originator of the war that has produced this change was the protagonist of the beet sugar industry in pre-war days. A fitting Nemesis surely!

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[1] To be had of TRUMAN G. PALMER, 901, Union Trust Buildings, Washington. See *I.S.J.*, 1917, 522, for a review of this Loose Leaf Series.

Preference for British Sugar Machinery within the Empire.

None too early the Council of the British Empire Producers' Organization is taking up the question of the preferential treatment of British sugar machinery shipped to destinations within the Empire, and it proposes to "make representations to the Governments and bodies concerned with a view to creating this preference where it does not exist and strengthening it where it is already in favour of the British maker, in view especially of the practical exclusion of British manufacturers from markets under American control and to the systematic attacks on British markets by the manufacturers of the United States."

It is only a common measure of justice that if manufacturers of sugar machinery in other countries secure what are virtually exclusive rights in their own territorial markets, something should be done to obtain for British manufacturers a similar advantage in British overseas markets. The only reasonable alternative is a system of give and take which would allow the rival manufacturing countries to compete on something like equal terms for the requirements of a sugar centre. Frankly, this alternative would be preferable for it would enable the buyer to select just what he thought best, instead of having as at present to take that machinery which the existing tariff makes the cheapest; and it would allow a sugar producing region to try machinery of different national origins and so make some relevant comparisons. This might be taken as an argument against the imposition of differential tariffs within our sugar Colonies and Dominions; but the main point is that so long as American and other producers are protected in their own territorial markets from outside competition so long is it invidious from a British point of view that they should also have free trade or at least an equal right of entry into British territorial markets. The proposed British preference would merely be a levelling up of respective rights, in default of the levelling down of existing tariffs which at present penalize the British manufacturer. Once the level is reached, it will be easier for mutual concessions to be negotiated. Under existing conditions the concessions would be all on one side, and that not the British one.

It is to be hoped, therefore, that the efforts of the British Empire Producers' Organization will meet with success.

Industrial Alcohol.

The high price of coal and the extending use of petroleum oil as a substitute for it (in particular as regards the employment of crude oil for marine steam raising and of petrol for motor traction) have rivetted attention to the desirability of furthering investigations into the possibilities of alcohol as an industrial motive and heating power. Expert opinions differ as to the time it will take to exhaust the coal fields and oil deposits of the world; but as regards oil in particular there is already a feeling of apprehension amongst scientists lest the vast use of oil as fuel for naval purposes as well as for huge passenger liners should prematurely exhaust the world's supplies in the not distant future. If that exhaustion were once a probability, then industry would have to fall back on alcohol, produced by fermentation or synthetically, to take the place of the oil.

It appears to have been shown that in most countries alcohol may be employed as a motor fuel with good results commercially, but hitherto its use has been so seriously hampered by fiscal safeguards aiming at the prevention of its simultaneous employment as a potable commodity, that so far the experimental stage has not been left behind. But the Board of Trade is now more alive to the utility of alcohol as a source of power and heat, and investigations are being carried out on a more thorough scale than was the case before the war. It is stated that the Fuel Research Board is making good progress in inquiring into the production of power alcohol in the British Empire. Undoubtedly, the chief peg on which the whole success or otherwise of the problem hangs is the ability to find a suitable cheap and effective denaturant, since otherwise the whole incidence of the taxation of spirituous drinks will be jeopardized. But it ought not to be beyond the wit of scientists to devise such a preventive, though it may be necessary for the fiscal authorities to relax some of their cast-iron regulations to enable alcohol to gain its rightful position as an alternative to coal and oil in industry generally.

Among the sources of alcohol that lie ready to hand is its distillation from molasses, the chief residue of sugar manufacture. The present seems an ideal opportunity not only to stir up the Government to encourage the use of molasses alcohol in industry, but also to educate sugar planters and others in the British Empire into the possibilities of using their surplus molasses in a new and profitable manner. At present the British West Indies can probably utilize all their molasses for rum manufacture; but the demand for rum will slacken off before long, especially with the spread of prohibition in America and elsewhere; so rum manufacturers cannot indefinitely count on a bumper trade such as the war period gave them.

But the whole question is one that might with advantage be investigated by a central body on behalf of planters and distillers, and it should not be left to the Board of Trade alone to undertake this. We suggest, then, that this is a subject that might be advantageously taken up by the British Empire Sugar Research Association. If this body would give the problem its early attention and investigate all the possibilities, it might be in a strong position not only to make representations to the Government, but also to direct the planters generally as to the best steps to take to ensure a permanent use of their waste molasses. But it may be advisable, first of all, for planters to indicate their willingness to be guided by such a body; they would do well, then, to come forward and request the British Empire Sugar Research Association to organize research on their behalf, so that the Association may have some assurance of possessing a mandate.

The British Engineers' Association.

Attention may be drawn to the British Engineers' Association (32 Victoria Street, London, S.W. 1.) an association of British manufacturing engineers and shipbuilders, which undertakes to provide a Central National Organization in the engineering industry for the protection and promotion of British engineering interests at home and abroad. Amongst other things, it deals with trade enquiries from foreign countries translating when necessary for its members, it employs special investigators and correspondents to investigate and report on overseas markets, and assists members to find suitable agents or representatives abroad. Finally, it runs a Trade Enquiry, Inspection and Information Bureau.

There has certainly been a large accretion of new trade organizations in this country the last few years, and it is to be feared that some of them are only redundant since they must overlap with other bodies. But there is much to be said for each main industry having its own organization since its officials will specialize in that one industry instead of trying to cater for every interest under the sun. As the British Engineers' Association is affiliated with that leading body, the Federation of British Industries, it is to be assumed that while it can itself look after its own sectional interests, it will have the assistance of the parent body in weightier matters common to all trades and industries.

The British Guiana Sugar Experiment Stations.

The plans to form sugar experiment stations in British Guiana under a Government ordinance, as mentioned in our issue of last November,[1] are being successfully carried out. A committee of five, drawn from the Sugar Planters' Association, was formed to meet Professor HARRISON and discuss all matters and make arrangements for dealing with the extension of sugar cane experiments in the colony. Professor HARRISON considers that in addition to the station at Georgetown, it will be necessary to have one at Berbice, one at Essequibo, and another on the West Coast. The committee have recommended that in future a larger number of seedling canes should be grown, so that tops in good condition could be obtained for distribution without interfering with the growing of canes for experimental purposes; they also suggest that the importation of foreign varieties for trial should be encouraged. As already announced, Mr. JAMES CRABTREE, M.Sc., F.I.C., has been offered and has accepted the post of Superintendent of the Experiment Stations.

Another Jamaica Central.

A contract has been entered into between the Grays Inn Central Factory Co., Ltd., of Jamaica, and Messrs. George Fletcher & Co., Ltd., for the supply and erection of a modern sugar factory and distillery for the 1922 crop. The plant is to be capable of producing 10,000 tons of 96° crystals per crop and about 2500 gallons of rum, and it will be of the latest type, the whole factory being electrically driven. Moreover, with a view to future expansion the whole scheme has been arranged to enable the capacity of the plant to be duplicated in the most economical manner, once the output is sufficiently big to warrant an extension.

Incidentally, it may be mentioned that this estate existed in the old days when sugar was a staple production of Jamaica, and it possessed a muscovado sugar factory erected in 1862, also by Messrs. George Fletcher & Co. Ltd. Unfortunately the cultivation of sugar was abandoned when prices ceased to be profitable and the factory fell into disuse. The ruins of the old plant remain however to this day.

The Cuban Crop.

The chief interest on the sugar market at the moment is the extent of the Cuban crop, estimates of which have jumped up and down the last few months. In May a shortage of a quarter of a million tons as compared with previous estimates was thought certain, and prices mounted accordingly. Now there is evidence that the crop will be in excess of the recent low estimates and may produce as much as 200,000 tons more than the Cuban holders have been bargaining for. The latter are also realizing that the pending imports into the U.S.A. of Java and Formosa sugars (estimated by WILLETT & GRAY to be over 600,000 tons in all) will not bode them any good, so there has been more disposition of late for the Cubans to sell their sugars, and prices in New York have come down a bit. Speculation now is rife as to whether the American consumption for 1920 will actually come up to anticipations; at the end of May it was a good bit behind the 1919 schedule, but as the heavy season has yet to come there is no knowing how much of the arrears may be made up during the last six months of the year. Should anticipations not be realized, then it is obvious that there will be a small surplus of sugar not bargained for by speculators, and some parties may be badly hit before the year is out. Further details as to the situation will be found in our Sugar Market Report on page 424.

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[1] *I.S.J.*, 1919, 536.

Fifty Years Ago.

From the "Sugar Cane," July, 1870.

MM. BOIVIN, LOISEAU & CIE. discussed in this issue the application of their process[1] to the clarification of cane juice. They described the preparation of the "sucrate of hydrocarbonate of lime," which compound was added to the juice, and the mixture boiled and filtered. It was claimed that "the reaction of the sucrate of hydrocarbonate of lime in the midst of the cane juice allows of the elimination of a large quantity of matter which is adverse to the crystallization of the sugar; it does not impart to the juice those discolorations which (more or less) accompany the common use of lime when employed to neutralize the acidity of the juice immediately on its issuing from the mill and to give it the alkalinity needful for the proper preservation of all the saccharine matter. . . ." Glucose was thus destroyed, and during the subsequent stages of manufacture the products could be maintained in the alkaline state from juice to final molasses. It was said that the syrups obtained from the juices thus clarified were "nearly colourless and limpid and easily boiled without becoming coloured"; while they crystallized readily, giving white and pure sugars which kept as well as beetroot sugars. There was a comment on this article by the firm of MM. PÉRIER, L. POSSOZ, J. F. CAIL & CIE. stating that Boivin and Loiseau's method was nothing more than an application of one of their patents,[2] and that these latter gentlemen could lay claim to nothing novel about the process, excepting the name by which they defined the compound formed in the juice by the action of carbonic acid on calcium sucrate.

DUBRUNFAUT gave an account of experiments which he had undertaken to investigate the reason why the syrup draining from some loaves would (contrary to previous experience) give no further sugar on crystallization. He showed this to be due to the formation by the action of yeasts of invert sugar "which comparable to properly formed grape sugar contains two distinct species of sugar, right-handed glucose, and the levulose of M. BOUCHARDAT." As a remedy the French *savant* recommended the refiner who had sent the sample to use lime in the clarification of his syrups and in the rinsing of his vessels, which advice is stated to have had effective results. In this article DUBRUNFAUT had an additional note on the Icery process,[3] giving analyses of two white sugars which had been made by "the mono-sulphite method of defecation and the most perfect apparatus." One of these sugars polarized nearly 100° and contained 0·05 per cent. of ash; while the other was only a little inferior, inducing the author to remark that "if the samples sent represent the regular results of the process, it demands the attention otherwise called to it by the enthusiasm of the Mauritians and the high reputation of the inventor."

In this number there appeared a review of a pamphlet by J. H. PORTER, Assoc. M. Inst. C.E., entitled "The Sugar Beet and Beet Sugar." He referred to experiments carried out at Mount Mellick, Ireland, and at Lavenham, Suffolk, and put in a strong plea for the manufacture of beet sugar in this country, stating that "there is no reason either in soil, climate, or amount of available cheap labour why the beet sugar industry should not be equally successful in this country, and that there are reasons why it should prove to be even more profitable" as compared with the industry on the continent.

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[1] English Patent, 54 of 1867. [2] English Patent, 1861 of 1859.

[3] *I.S.J.*, 1920, 71, 126, 271.

Among other articles in this number were "Some Remarks upon the Cultivation of the Sugar Cane in the Leeward Islands," by J. SPENCER HOLLINGS; "The Absorptive Power of Soil," by ROBERT WARINGTON, F.C.S.; "A New Sort of Manure made from the Residues of Distillation," by B. CORENWINDER; and "The Projected Abolition of Slavery in the Spanish Colonies," by an anonymous writer. One patent only was noticed, that of M. DOMINIQUE for the clarification of juice by the use of aluminium phosphate.[1] After defecation with lime, the juice was allowed to settle, and decanted as usual. Aluminium phosphate "in a liquid state" was then added to it gradually as long as a white flocculate precipitate formed, or until red test-paper indicated a neutral or feebly acid reaction. This precipitate consisted of tricalcium phosphate and aluminium hydroxide, which carried down albumenoid and colouring matters with it, and no doubt exercised a good clarifying effect. It was separated by filtering through Taylor bags, and the clear liquid was concentrated and crystallized. Among the advantages claimed was the abolition of animal charcoal and of carbonic acid; the yield of a good quality and quantity of sugar; and the production of a mixture, consisting mostly of phosphate of lime and nitrogenous substances, which was claimed to be capable of being utilized as a "powerful manure."

Agricultural Notes.

Windrowing in India.—The sugar cane crop in North India has, as in the United States, a comparatively short growing period, and there is sometimes a considerable gap between the time of harvest and the proper planting season. In places, the temperature is too low for the canes to germinate, in others it is the dry time of the year and there is not sufficient moisture for the young plants to grow, and yet in others the ground is still occupied by cold weather crops.

In no part is this interval, perhaps, more sharply defined than in the Punjab, where some 400,000 acres are grown every year with the most primitive canes in the world. Thus, in the Jullunder district, in the heart of the "garden" area of the Province, where sugar cane occupies a larger proportion of the cultivated land than anywhere else in India, the reaping season commenced in the first week of December, while the proper planting time is from the middle of March to the middle of April, although it may sometimes be later. There are three ways in which cane seed may be preserved in the Jullunder district. The commonest is to cut the required quantity of canes (one twentieth of the desired crop is the rate), top the canes and carry them to the field next to be planted: the bundles of canes with all their closely adhering leaves are laid horizontally in shallow pits on the ground and covered with about six inches of soil. On viewing the land in February, a number of earth mounds are seen at intervals along the borders of the fields, reminding of the similar heaps for storing roots for fodder in this country. Being interested in these heaps the writer had one opened after two months burial, and the accompanying photograph (given on the plate) shows the appearance of the canes inside: the field note at the time runs "canes fresh, intact, neither rooting nor shooting," Another plan, used only with Dhaulu, a rather delicate variety, is to cut off 9 in. under the tops and bury bundles of 200 to 250 of these upright in the soil. This method is probably imported from the more favoured sugar cane regions to the south-east, as will be shown later. Lastly, canes for seed may be left standing. This method is liable to two disadvantages, loss by pilfering and cattle trespass, and injury by frost. The writer has passed through the country in the early months of the year on several occasions and, on one of these, after a rather sharp frost, the little blocks of standing canes were as if blasted by drought. Not a single trace of green was to be seen in the heavy masses of foliage which were of a dull brown colour, all of the leaves having been killed by the frost. Although they might still be harvested, they could not be expected to produce any seed for planting. If however the plants survive and enough are left by thieves, it is claimed that canes preserved by this method produce the best seed for planting purposes.

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[1] French Patent, 87,631 of 1869.

Passing to the other end of the great North Indian sugar cane tract, in parts of Bengal, although frost is no longer to be feared, drought and parching winds and sometimes the presence of cold-weather crops make it still necessary to preserve the cane seed for six weeks to two months. The writer has studied the method employed in the Birbhum district, and it conforms to the second of those mentioned above, namely the preservation of bundles of sets placed upright in the soil. In past times the cultivation of the sugar cane in this tract was perhaps about the best in the world, and the following details have been taken of the practice followed in the middle of last century when the industry was at its zenith.[1] The crop is reaped from January to March and only the tops are used for seed preservation: these are closely packed and placed upright in an excavation 2 to 6 ft. sq. and about 8 in. deep; the cuttings vary from 9 to 18 in. in length and thus half of them project above the ground. Moist earth is placed around and a watering is given: dry leaves are piled loosely over and afterwards watering is done every two or three days to keep the sets moist. In a week or two they begin to shoot: when after a month these shoots are 6 to 12 in. long the sets are taken out and each is cut by sharp blows of a bill hook into two or three pieces, each of which should possess at least two buds. The smaller sets are now replaced in the pit, called the "haupper," and a solution of cow dung, clay and oil cake in equal quantities is poured over in the form of a thin mud, so as to cover the mass in a plaster of the composition: leaves are again thrown over and watering done as before. From the original sets at least twice the number will ultimately be obtained, and the careful treatment described is designed so as to have none but sound sets at planting time: these are found difficult to supply after the usual planting in April when showers are expected. By this time any cold-weather crops will have been reaped (February to March) and the ground suitably prepared for sugar cane.

An entirely different nursery system is in vogue in the Ganjam district of the Madras Presidency, where the interval between harvest and planting time is due to the absence of water in the irrigation channels, but a description of this interesting process will have to be left for another occasion.

The effect of windrowing on the juice of the cane.—A great deal of attention has been paid during recent years to the possibility of erecting a sugar factory in the Peshawar Valley of the North West Frontier Province of India. This region is distinct from the North Indian sugar tract and owing to the mildness of the local climate good crops of thick canes can be grown. There is practically only one kind of cane grown and this, although not very rich in sucrose, gives a very fair tonnage at harvest: from 30,000 to 40,000 acres are under this cane within a small area. With only a single variety of cane grown it is obvious that the milling period is likely to be limited and any chance of making a factory pay would be enhanced if it could be extended, so as to bring a larger area under contribution. Presumably with this idea in view a somewhat detailed study has recently been made by the Agricultural Chemist to the Government of India of the effect of storing the canes on the character of the juice. During the past two years an assistant has been deputed to this work and a large number of analyses have been made at frequent intervals. In the year 1918-19 the crop dealt with was divided into three parts which were cut and windrowed at successive periods. The first lot was cut and analysed on December 18th and immediately buried: the second was similarly treated on January 10th and the third on February 3rd. Analyses were made of the buried canes in all of them at short intervals.

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[1] H. S ROBINSON, *The Bengal Sugar Planter*, Calcutta, 1849

The following summary of results has been prepared by Dr. HARRISON the Imperial Agricultural Chemist:[1]—"A study of the analytical data obtained showed that the total solids, as measured by Brix, increase during the period of storage, and that the juice becomes more and more concentrated as time goes on. At the same time the percentage of both glucose and sucrose increases, so that the juice of a windrowed cane contains a larger proportion of these constituents than does the original cane. On the other hand, the glucose ratio widens, and there is a slight increase in the proportion of 'solids not sugar,' so that a falling off in the quality of the juice is to be expected. That this is so is shown by the change in the coefficient of purity, but this is not so great as might be expected, and in fact, owing to the increased concentration of the juice the variations in the percentage of crystallizable sugar are practically nil. Consequently the process of windrowing does not lead to any appreciable decrease in the amount of sugar obtainable from equal weights of juice.

"It does notfollow from the above, however, that there is no loss of sucrose and sugar so far as the crop is concerned, and this point can only be determined by careful weighments of the samples drawn and of the juice expressed. Such measurements were taken at each stage and the weights of sucrose, glucose, etc. calculated to the basis of 1000 lbs. cane when windrowed. The results obtained were remarkably concordant.

"The amount of sucrose present in the cane windrowed on December 18th increased rapidly up to January 1st, and then remained practically constant until the first week in February after which there was a rapid decrease. The cane windrowed on January 10th showed a similar increase at first and again deterioration set in after the first week in February, whereas the cane windrowed on February 3rd showed a continuous decrease. Similar fluctuations occurred in the weight of cane, weight of juice expressed, and these are particularly well brought out in the case of crystallizable sugar. The weight of glucose, on the other hand, tends to increase uniformly. All these comparisons show that the cane can be stored by windrowing for some time, but that after a certain time has elapsed deterioration sets in."

It is further noted that the date at which deterioration set in was the same, whether the canes were windrowed in December, January or February, and a study of the weather records showed that at this date a heavy rain occurred. In the previous year cane windrowed in December showed no sign of deterioration for four months and here too this set in after a heavy fall of rain. Dr. HARRISON, from this and other considerations, has provisionally selected the rain factor as that which determines the period during which windrowing can be safely carried out for crop purposes. The experiment will be continued.

C.A.B.

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[1] "Scientific Reports of the Agricultural Research Institute," Pusa, 1918-19, pp. 40-41.

The Growth of the Sugar Cane.[1]

By C. A. BARBER, C.I.E., Sc.D., F.L.S.

VII.

The length of the cane depends on two different factors, the length of the individual joints and their number. Taking the cultivated cane plant in general, there would not appear to be much difference among the varieties in these respects. In every case the number of joints is considerable, for as each joint bears only one leaf and these are constantly growing old and being discarded while new ones are appearing at the top, the continued formation of fresh joints is a necessity in a growing plant. Given the conditions necessary for continued healthy growth, the plant will thus go on forming joints until it dies or, as is so often the case, arrows: then all growth in length ceases. Joints once formed and meeting the eye of the observer do not increase in length, for, as we saw in the last article,[2] the increase in length of the individual joint takes place while it is still hidden in the mass of young leaves and, indeed, completes itself in a very short time. After that, the joint never alters in size, and the increase in length of the cane is entirely due to fresh joints being added above those already formed. By counting the joints at harvest time, we can at once tell how many leaves the plant has produced above ground, those in the terminal tuft being of course added.

In spite of this general uniformity, we have short and tall canes, long and short-jointed forms, canes with comparatively many or few joints. And these are, all of them, matters of importance in regard to the amount of crop yielded. The height of a field of cane will, as everyone knows, vary a good deal according to the weather, the soil, and the care in cultivation and amount of manure applied. And the effect of these external variations is perhaps more to be seen in the length of the individual joints than in the number produced. The length of the joints is immediately affected by any local injury, the plant reacting against such injury by producing for a time, or permanently, shorter joints: and any cane not growing well will show its condition in the joints as well as in the leaves, by producing shorter ones. Thus B. 208, which has been most extensively tried in all parts of India because of the richness and purity of its juice, has on the whole been disappointing, being usually characterized by thick short joints with a strong tendency to shooting at the nodes. The climate appears to be generally too dry and perhaps the heat is too great for this cane to do well; but the writer has met with it in two widely separated districts where good, long joints are formed without much shooting, and the canes here were of so different a form that it was difficult to believe that it was the same kind of cane. Repeated observations have shown that in no character does the cane plant respond more readily to climatic conditions than in the length of the joints: and in parts of Bengal, at reaping time, the portion of the cane growing at the onset of the monsoon can be readily marked. An extreme case of this kind of periodic change in the length of the joints is shown in the reproduction of a photograph, shown on the accompanying Plate. Beyond that these canes were grown in Central Queensland nothing is known of the details of the crop, but it would have been interesting to learn what was the cause of the change. It may be suggested that the simultaneous shortening of the joints in all the canes of the crop shown had something to do with the approaching end of the growing period: but its long continued nature might also suggest a marked period of drought succeeding good growing weather. We shall return to this aspect of the subject later on, merely noting here that sudden climatic changes have again and again been seen to produce similar changes in the length of the joints.

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[1] The previous articles of this series appeared in our issues of October, December, 1919, February, April and June, 1920.

[2] *I.S J.*, page 313.

Another factor which has influence on the length of the cane joint in a given plant is the period at which it is formed. We have seen[1] that the early and late formed canes of a clump differ very considerably in this respect. The first formed canes are distinguished, among other things, by relatively shorter joints than those arising later in the plant's growth; but, in spite of this, the earlier canes produce so many joints that they are usually the longer. This makes it rather difficult to determine accurately the appropriate length of joint in the different varieties. But a further difficulty is met in the fact that in each individual cane the length of joint varies a great deal with the part of the cane where it is measured. Commencing with extremely short, disc-like joints in the part, usually below the ground, where the plant is engaged in attaining the thickness proper to the variety,[2] the length of the first joints above ground rapidly increases as we pass upwards. During the period of active growth a succession of good, long joints is formed and, towards the close of this period, they often become quite short before the cane is cut at harvest. When flowering occurs this normal curve of growth is interrupted at the end, in that the joints at the top become longer again, sometimes enormously so, and it is thus possible to tell, long before there is any appearance of the future inflorescence swelling within its sheath, that the cane is going to arrow: the leaf sheaths become also longer while the blades become shorter, and the joints greatly decrease in thickness and become useless for the crop.

In attempting to judge the length of joint appropriate to the variety, one would in these circumstances naturally confine one's attention to the middle of the cane, assuming that in this part the joints would remain more or less constant and indicate the normal length attained. But this is far from so simple a matter as it appears, for the joints vary a great deal even in this part, and there is some evidence of a rhythmic change in length during active growth, waxing and waning periodically. But the most important point brought out by a careful study of a very large number of canes is that the longest joints are to be found much nearer the ground than the middle of the cane. The length of the joints from base to apex has been measured by the writer in many thousands of canes, and in a batch of 2000 belonging to widely different varieties (entailing some 40,000 measurements) it was found that, on the average, the fifth and sixth joints above the ground were the longest. It was also noted that the very first joint above ground was comparatively long, that the increase in length was very rapid till the maximum was reached, and that, further up the stem, there was a regular fall until the short joints at the end of the growing period were reached. As there were, on an average, 20 mature joints in each cane, the point at which the longest joint was met with was thus exactly one quarter of the way up, counting the number of the joints. The following were the averages, in inches, for this series of measurements, from the ground to the highest matured joint of the cane:—3·4, 3·9, 4·2, 4·4, 4·5, 4·5, 4·4, 4·4, 4·2, 4·0, 3·9, 3·7, 3·6, 3·4, 3·2, 3·1, 3·0, 2·9, 2·7, 2·6. These figures of the average length of joint in the 2000 canes are graphically shown in the accompanying Diagram (page 373) in the curve marked "General," and this graph shows very clearly the typical joint curve of a sugar cane.

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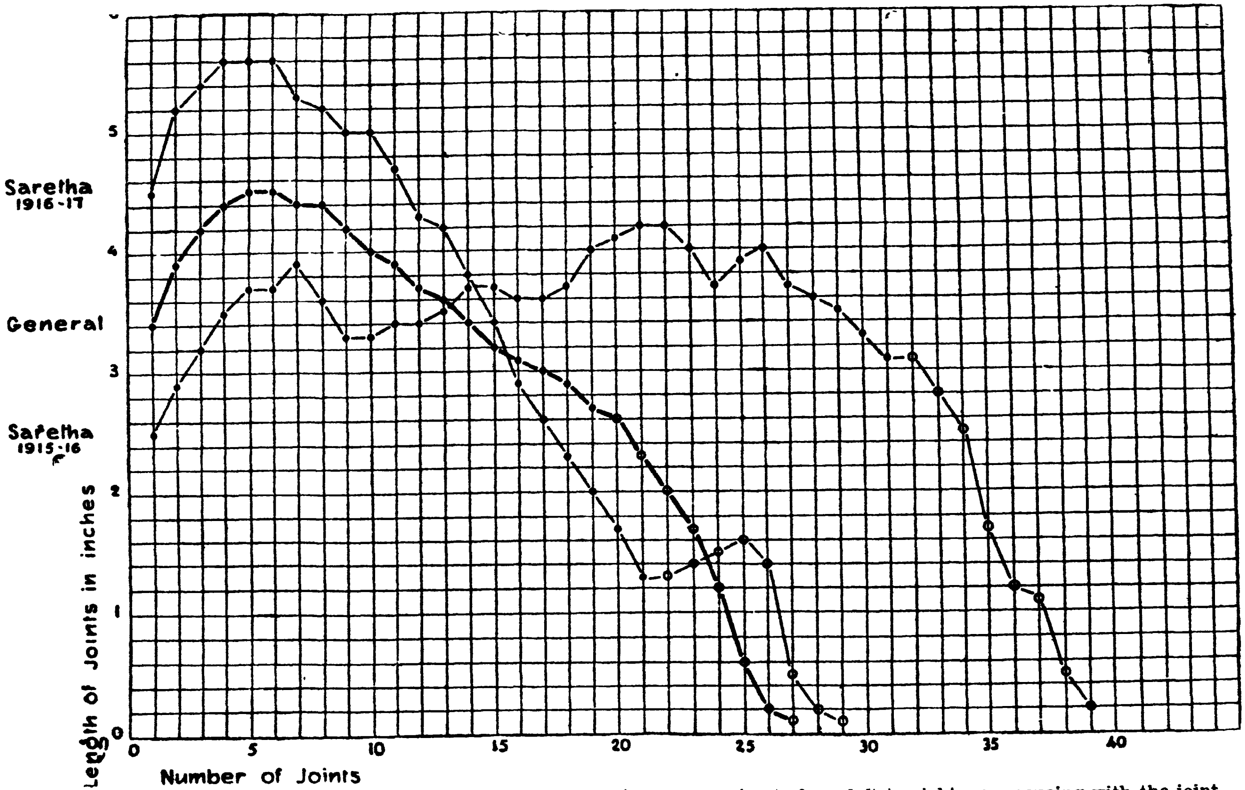
[1] *I.S.J.*, page 201. [2] *I.S.J.*, page 313.



Joint Curves in the Sugar Cane. The dots represent successive joints from left to right, commencing with the joint at ground level. The circles at the end represent the immature joints at the top.

This Diagram is reproduced by kind permission of the Agricultural Adviser to the Government of India, from the paper by the writer referred to in the text.

At the same time that the joints were measured in all these canes, various other measurements were made, including the lengths of the leaf blade and leaf sheath, and typical curves were obtained which differed very widely from that of the joint. We can here only very briefly refer to that of the leaf blade. The lamina borne by the first joint above ground is usually about a yard long, and succeeding leaves are longer and longer until a maximum is reached, as in the joint. But this maximum, which is usually from 5 to 6 ft., is reached much later than in the joint. When it is attained the succeeding leaves remain very uniform in length during the period of active growth, while towards the end of the growing season the length rapidly decreases. The general curve is therefore a flat one as compared with the sharp-pointed one of the joint, and it is probable that, as long as the cane plant is growing normally, the length of leaf blade remains fairly constant. As an example, we will take the measurements of the leaf blades in the Saretha group of Indian canes, and the averages given below are those of a very large number of canes in different members of this long-leafed group of canes. The following are the figures, in inches:—37, 38, 42, 45, 48, 51, 52, 53, 54, 55, 56, 56, 56, 57, 57, 57, 57, 56, 57, 57, 57, 57, 56, 55, 55, 54, 54, 53, 51, 48, 37, 26, 17, 8. In this series it is seen that the actual maximum was not reached until the sixteenth joint, and that for 28 successive joints the differences in length were less than 10 per cent. All the leaves of the plants were measured from the first joint above ground upwards until a lamina was reached at the top of the plant less than 1 ft. long.

Let us now return to the curve of joint length, which concerns us more especially. From the mass of material recorded I propose to describe a case which shows that, with a little study, the length curve of the joints taken at harvest bears, indelibly stamped upon it, the nature of the past growing season, and that any abnormality will make itself clearly noticeable. This method has been extensively used in a paper by the author[1] dealing with the suitability of any cane for the locality in which it is growing, the observations being made once for all at crop time, instead of in a continuous series throughout the season. The work can thus be extended to a large number of districts by simply deputing a careful subordinate to make measurements according to a given schedule.

In a series of measurements thus obtained at Samalkota in 1915-16, the curves showed certain peculiarities which tended to discredit the reliability of the method; those of the joint length in four kinds of cane, although agreeing remarkably among themselves, were quite abnormal: they even resembled the flat leaf curves rather than the typical sharp joint curves which had been obtained in hundreds of cases all over India. The curve obtained for Saretha in that year is shown in the Diagram. It is seen that the maximum joint length, although approached in the seventh joint, was not actually reached until the twenty-first; that between the seventh and twenty-sixth joints only minor differences in length occurred; and that the curve was very long, no less than 33 joints being formed and matured before the rapid diminution of length at the top of the cane. In 1916-17 the observations were repeated at the same place with the same set of varieties which had been growing for the same number of months. In every case a typical joint curve was obtained, and that of Saretha is again reproduced on the plate. Saretha is a cane that has a rather greater number of joints than most others and, in the second year, it is seen that there were not appreciably more than the average for the whole series of canes of this and other varieties dealt with in the "general" curve. The canes in this year were therefore just as few-jointed as those in the previous year had been many. The maximum is high, as is usual with Saretha, was reached very quickly, namely in the 4th joint, but the descent was more rapid than usual to the 21st, when the immature part of the cane was reached.

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[1] C. A. Barber, Studies in Indian Sugar Canes, No. 5. "On testing the suitability of sugar cane varieties for different localities, by a system of measurements. Periodicity in the growth of the sugar cane." Memoirs of the Department of Agriculture in India. Botanical Series, X, 3, 1919.

As this divergence of the joint curves (shared in by those of the leaf lamina and sheath) was so unusual, a careful study was made of the weather records published every year by the Station. The explanation was at once found there. To summarize, the monsoon was delayed in 1915-16 and the canes had a difficult time at the beginning of the season: later on things improved and the latter half was peculiarly favourable to rapid cane growth. In 1916-17, on the other hand, the monsoon broke very early and the rain was satisfactory right up till October, when canes were commencing to be formed rapidly: then the difficulty, often experienced in the delta, was to get the land drained, and even paddy suffered considerably from the excess of water on the land. In both seasons the amount of rain that fell was reported to be "well above the average": in 1915-16 the first half of the season was unusually bad and the second unusually good: in 1916-17 the reverse was the case. This clearing up of the difficulty was opportune, and added strength to the conviction which was forming in my mind that a series of careful measurements made at crop time may be relied on to reproduce the character of the cane growth throughout the season that has passed. Further, that from a study of the joint and other curves of growth, obtained by local officers, the suitability of a tract for cane growing in general may be judged, and reliable data may be obtained as to the relative suitability of a number of different varieties being tested.[1]

The British Guiana Sugar Industry.

By F. I. SCARD, F.I.C.

Sugar is paramount in British Guiana, and the maintenance and development of the industry is a matter of primary importance to that Colony. As matters now stand, in spite of the increased quantity of sugar extracted from that in the cane as the result of improved machinery and methods, the sugar crop of the colony is less now than it was thirty or forty years ago. The question is, leaving outside the matter of labour supply, what can be done in field and factory to remedy this state of things?

The first point is, naturally, the cultivation. The bulk of the estates of the colony have come to the end of their tether as regards new land, and are now feeling the effects of the system of cultivation which has been in practice with them. Canes have been grown continually, with practically no rest for the land, and nothing done in the direction of green manuring, even the canes being "burnt" in many instances before cutting, which has the effect of depriving the land of the benefit of the "trash" of the canes. The result has been that there is a constant loss of humus; the proportion of the latter approaches the vanishing point, and infertility results.

There is however, one way at any rate of ameliorating the situation, even if the method does not completely meet the requirements. This is by periodic flooding of the fields. Fortunately, all the estates in the colony have the means of doing this through the various water conservancies and creeks, and all that is required is the necessary pumping machinery. A systematic manner of carrying out the process would be to make such arrangements as would permit of these periodical floodings. British Guiana estates are already divided into sections, which would greatly facilitate the work. Under this system, a definite proportion of the cultivation, when the time came for its treatment, would be shut off from the rest of the estate, and flooded to a depth of six or nine inches; after remaining in this condition two or three months, the water would be run off. The effect of the flooding would be to kill all vegetation and thus provide humus. The area would now be allowed to remain for some time until a new growth of plant life has taken place, when it is again flooded with the view of its destruction and the supply of more humus; and the alternate operations are repeated, until at the end of eighteen months or so the area is fit for replanting with canes.

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[1] C. A. BARBER, *Ibid.*

The difficulty in connexion with this treatment is that a considerable proportion of the cultivation is thrown out of action, with a consequent diminution in the acreage reaped annually. But the increased return per acre of that reaped would ultimately be so much greater as to compensate for the less area cropped, although at first some loss of crop would be felt. Unless something of this sort is done to regenerate the exhausted lands, the older cultivation will have to go to the wall, and with it the chance of prosperity for the British Guiana sugar industry.

It is true that there is an abundance of good cane lands in some parts of the hinterland of the colony; but in the absence of labour the opening up of these and of the necessary communication with the sea for shipping is out of the question.

Another point in connexion with the cultivation is that of the canes themselves. This has, however been well taken up by the proprietors and the official Agricultural Department, and all that can be done in the way of the introduction of new and suitable canes is being done.

In connexion with the soil, much could be, and doubtless will be, done in the direction of mechanical tillage, and the thorough treatment of the soil which this would provide for would not only reduce the labour tension but conduce to bigger returns.

The extensive use of lime and slag phosphate would also materially help the situation. The former would help to keep the soil open, while there is an especial property in the latter, a something unknown of which agricultural chemists have not yet discovered the nature, that renders it a more valuable manurial agent than the mere phosphoric acid and lime in it indicates.

On the factory side, British Guiana is much behind the times—the factories which possess new and complete mills are very few in number, the milling plants being mostly made up of units collected from various sources, or of old mills to which additional new units have been added. Quadruple crushing is unknown, maceration is carried out only to a limited extent, and it may be taken that the extraction of sugar from the cane in the milling department is a long way short of what it might be.

It is much the same way in the boiling department. The evaporators are not sufficient to deal with the necessary amount of maceration water; the vacuum pan department is also as a rule deficient, while crystallizers are few and far between. As with the mills, the boiling-house department is scrappy. The factories want, like the soil, regenerating, the weak parts removed and replaced by new, deficiencies made up, and the whole reorganized.

It would be a wise course to abandon a large number of the factories and erect new ones; and this leads to the question of the amalgamation of the estates. Although there has been a tendency in recent years for the smaller estates to be absorbed by the larger ones in their neighbourhood, the process has not been carried far enough. Every effort should be made to give effect to this process. It should be remembered that a 10,000-ton factory is looked upon in the present day as being the smallest economic size, and there are few estates in British Guiana which turn out a crop of that size.

For the future welfare of the British Guiana sugar industry, it is essential that:—

(1) The played out soil be regenerated and a system adopted for securing in the future the maintenance of its fertility.

(2) The machinery of the larger factories be brought up-to-date, as to admit of the maximum of extraction of sugar being obtained.

(3) New factories be erected to deal with the canes of the smaller estates, which should be amalgamated for the purpose.

It is unfortunately an extremely inopportune time for the purchase of machinery on account of the abnormally high price and the difficulty of obtaining delivery, but a step in the right direction would be to initiate the treatment of the soil in the manner suggested. It is nothing new in the sugar world, having been in practice in Surinam many years ago, where as soon as land failed to give a certain return, flooding as described was resorted to. With the high price now obtained for sugar the present time would be most suitable for putting the system into force, as the financial effect of the diminished crop which must first occur would not be so severely felt. Such a system would also ease the labour situation. It takes the same labour to cultivate a field giving a poor yield as one giving a good return.

Nothing has been said in the above as regards the actual working in the factories, especially in relation to chemical control. Modern methods of boiling the sugar with a view to maximum extraction demand that the operations should be conducted under an organized system of scientific supervision. This the British Guiana estates lack. It is true that the larger estates mostly employ chemists, but the duty of these does not cover the ground that it should. Indeed, their scarcity renders this impossible, and there is nothing approaching the scientific control which has helped to make the Java, Mauritius, Hawaii and other up-to-date sugar industries what they are.

Associated with the more complete chemical supervision of the factory, a highly essential factor in success is the system of mutual control whereby the individual factory manufacturing results are compared for the benefit of the industry as a whole. No doubt, when the factories are reorganized, and thoroughly equipped, the existing system of scientific control will be amplified. At present British Guiana is a long way behind other advanced industries.

An interesting cinema film, illustrating the design and operation of the Gee centrifugal separator, was recently shown at Vickers' House, Westminster. A suspension of whiting in water was treated. The machine was first shown at rest with its drum below the ground level, suspended by its special bearing, which enables a weight of 2½ tons to be rotated at 1000 revs. per min. with no risk of precessional oscillations. The container holding the residuum plates, on which the cake is deposited, was shown hoisted above the ground level by the lifting gear attached to the machine. The next operation was the placing of the residuum plates in position. As the container was lowered into the drum, the machine was started, the lifting attachment disconnected, and the feed pipe directed into the drum The picture then showed the feed cut-off; the machine stopped, the container lifted, and the residuum plates removed—each with a thick cake of deposited and graded whiting. British patents relating to this interesting machine are: 4155 of 1907; 21,421 of 1909; 16,188 of 1911; 24,803 of 1911; 9365 of 1915; 106,669 of 1916; and 113,326 of 1917.

Continental Beet Sugar Notes.

(By Our Correspondent.)

In our February issue we pointed out how in some Continental countries the splitting up of large estates into small holdings would certainly affect *beet growing;* and now we want to draw attention to quite a contrary movement in the *manufacture of sugar* in other European countries, where a merging of independent sugar factories into large combines and a concentration of the sugar distribution in a few strong hands is actively proceeding.

A paper in the *Journal des Fabricants de Sucre* of 31st December, 1919, gives the following history of the establishment of a sugar trust in Italy. The "Unione Zuccheri" dates from 1904 and very soon after its establishment it succeeded in concentrating the sugar interests so as to control in a short time two-thirds, if not as some reports say four-fifths, of the whole Italian sugar production. The Unions ruled the production and the home prices, decided which factories had to work and which had to remain idle during a campaign, in order to place the production in accord with the consumption ; and it managed to keep prices at a high level in Italy. During the war it was not content with that part of the business and went on to establish a "Syndicate" for the supply of beets to the factories. This body looks after the purchase of beets in all its details and controls 96 per cent. of the total sowings, including those of beets destined for the distilleries. Thereby all competition is excluded so far as the users of beets for industrial purposes are concerned and the syndicate is the sole buyer. In order to counteract this monopoly, the beet growers have now combined to form a federation of beet grower's syndicates, with a seat in Bologna, while the workmen and employees have also formed federations and associations, comprising all those who work in the sugar factories and distilleries. The result is that in Italy all the work connected with growing beets and working them up into sugar, molasses, and alcohol is ruled by collective groups, which can discuss matters on an equal footing.

One gleans from the *Avenir Agricole* of Brussels the following on the same subject in Belgium. The Belgian sugar production has gone down since 1914 by 70 per cent. ; in other countries the diminution has not gone so far, but, anyhow, sugar is getting scarcer every day and prices are rising rapidly. Just as has always been the case in such circumstances during the course of history this state of affairs leads to wholesale buying up ; but in Belgium it is not so much the ready sugar which is accumulated in the hands of a very few, but the means of production, i.e., the sugar factories.

The Tirlemont refinery has bought a number of sugar factories in the Kesbaye, and thereby will be able to refine during a large part of the year sugar from its own sugar-houses. Moreover, being independent of its sources of supply, it will be in a condition to impose its will upon the other sugar factories and through these upon the beet growers of a great portion of the country. If the Government does not levy a large duty on the product of that concern, the latter is sure to reap enormous benefits and this is the more to be regretted, because these will enter the pockets of a very few individuals, belonging to a family of wealthy sugar men. Next to this concern, the enormous factory at Wanze, near Huy, which already now works up the juice from 14 slicing stations, connected with the main factory by pipe lines, contemplates extending its ramifications. Nowadays, the capacity of that establishment is 3500 tons of beet a day or 180,000 tons per campaign. This raw material will yield 17,000 to 18,000 tons of sugar per campaign, produced as white sugar, to be sold immediately to the retailers, exclusive of a large quantity of raw sugar for refining purposes and a quantity of molasses. The Board of Directors propose to extend the works to a daily capacity of 5000 tons of beets, equivalent to one-tenth of the total Belgian pre-war sugar production.

It is evident that if such large establishments develop, the smaller fry in their vicinity are bound to disappear, either by disposing of their property to the big neighbour or by just closing down. Very probably the number of active sugar factories in Belgium will undergo some reduction, although the production may increase.

In 1919 a big company was floated in the Netherlands with a capital of 30 million guilders, of which one million were issued in preferred stock at 10,000 guilders per share and the balance in common stock in shares of 1000 guilders. The new company took over the refineries and sugar factories belonging to the Western Sugar Refinery in return for Fl.6,600,000 in ordinary shares, the Hollandia factory of Milk Products and Foodstuffs in return for Fl 4,200,000 in ordinary shares and the firm of Van Loon & Co. against Fl.1,200,000 in ordinary shares. Sixty preferential shares were taken out by a few sugar men. The company next bought the overwhelming majority of the shares in a number of sugar factories. They paid for the latter in ordinary shares and in money, which latter was forthcoming from the public who took the balance of the ordinary shares. At this moment the ordinary capital of 29 million guilders in the "Central Sugar Company" has been subscribed and paid up, together with 600,000 guilders in preferred stock. This company possesses in full property three refineries with a weekly capacity of 5000 tons, and five sugar factories with a capacity of 400,000 tons of beet per annum, and moreover holds the majority of the shares in eight other sugar factories, having a capacity of 900,000 tons of beets per campaign.

Altogether the new company controls the production of 13 of the 21 Dutch sugar factories and three of the four big refineries. Only one large and a few smaller refineries or rather syrup and candy factories are still independent. Finally, the company has entered into an agreement with the seven co-operative sugar factories, under which it will direct the sale of their production along with that of its own factories. The result of all these transactions is that the "Central Sugar Company" possesses the actual monopoly of the production and sale of the Dutch domestic sugar production. The only independent refinery will have to buy sugar from abroad in order to be able to work, and in these days, when sugar cannot be exported from either Belgium or Germany and the cane sugar production of the colonies is extraordinarily expensive, it will be very difficult to obtain a good supply of the raw material, without applying to the competitor.

In 1907 a sugar trust was formed in Sweden, under the name of "Swedish Sugar Factories Company" with a capital of 135 million crowns. This powerful combine owns 18 sugar factories out of the 21 existing, and nine out of the 10 sugar refineries. Thus only three sugar factories and one refinery are outside the combination.

Finally, in Denmark a big company, called the "Danish Sugar Factories Company" has secured possession of seven of the eight sugar factories and two out of the three refineries.

The British Consul at Colon, Panama, makes reference to a possible opening in that Central American republic for sugar machinery of British manufacture. It is stated that there are prospects of a considerable growth of sugar cane being undertaken on the isthmus.

Australian Affairs.

(From Our Special Representative)

Since last writing an immense change has come over the prospects of the sugar industry, and it should now be on a more stable and permanent basis than has ever been the case since its inauguration in Australia. For several years past the growers and millers, justly or otherwise, have maintained that the prices paid to them for the cane and raw sugar were not sufficient to enable the industry to be prosperous enough to carry the extra cost involved by the higher rate of wages paid to white, as against coloured, labour. Still the industry pegged along. These murmurings became more loud of recent years, when the price (£21 per ton for raw sugar) paid by the Federal Government was in glaring contrast to the world's high rates during the war, more especially as the Arbitration Court in Queensland kept steadily increasing the wages to the workers. The grievance took concrete form early this year, when the Council of the Australian Sugar Producers' Association, at its February meeting, passed a resolution as follows: "That this Council requests the Commonwealth Government to continue the control which it has been exercising in connexion with the sugar industry, and reaffirms the resolution previously passed, viz.: 'That the control of the sugar industry be transferred to the Commonwealth, subject to the appointment of a competent tribunal or tribunals, to safeguard the interests of every section of the industry.' That in view of the greatly increased cost of production, and the well-established fact that pre-war conditions will not recur within measurable distance of time, if ever, 3½d. per lb. at the port of shipment is a fair and reasonable price to ask for raw sugar; and that, in order to stabilize the industry, the relative agreement to be entered into between the Commonwealth and State Governments should be for a period of at least five years." This was followed by a conference in Brisbane, at which all the allied interests (except the Commonwealth Government) were represented. After discussing from all points the position of the industry, it was decided to approach by deputation the Prime Minister of Australia (Mr. W. M. HUGHES) with a request for an increase of price for raw sugar from £21 to £30 6s. 8d. A representative deputation journeyed to the south to lay the matter before him, and a conference was held in Sydney on 15th and 16th March, at which the Federal and Queensland Governments, the A.S.P.A., United Cane Growers' Association, Australian Workers' Union (with which most of the sugar workers are allied), and Colonial Sugar Refining Co. were represented. The Prime Minister had also been informed by the Queensland Arbitration Court judges that in the incoming new award it was almost certain that a further increase of wages would be granted. The upshot of this conference was that a new agreement was evolved, of which the following are the salient points:—The price for raw sugar to be £30 6s. 8d. per ton for 96 per cent. net titre sugar, the increase of £9 6s. 8d. to be allocated—£4 per ton to the sugar mills and £5 6s. 8d. to the growers on the basis of a present price of 30s. 6d. for cane at 12 c.c.s. The new agreement between the Commonwealth and Queensland Governments to be for not less than three years. £30 6s. 8d. to be the minimum price for that period. A council—consisting of representatives of cane growers, millers, sugar workers, Queensland Government, and Commonwealth Government, of which the representative of the latter shall be chairman—shall, in February of each year during the currency of the agreement, review the price, and may grant an increase, not, however, to exceed the increased cost of production paid to workers through increased cost of living, such wages to be fixed by the Queensland Arbitration

Court which shall only increase wages to meet the increased cost of living. Power is given to the Queensland Government, to call a conference, comprising the chairman of the Queensland Cane Prices Board (to act as chairman, with a casting vote) and six representatives each of the A.S.P.A. and U.C.G.A., but any amendments emanating from such conference will not operate until after the end of the 1920-21 season.

The Queensland Government agreed not to legislate or administer in any way inconsistent with the Agreement, but to give full effect to it. The agreement was duly brought before the Federal House of Representatives by Mr. HUGHES, and is being acted upon by him and his Ministers. In laying the matter before the House, Mr. HUGHES stated that he had to consider the effect this transaction would have upon Australia, and he thought it was profitable and advisable to encourage people to settle on the Northern sugar lands even if the price of sugar did fall outside this continent, and whatever extra the people paid it was essential for their national and industrial welfare. If the agreement was not accepted, sugar in Australia would be 2d. to 4d. per lb. dearer during the next 12 months, besides disorganizing the industry and giving it a decided set back. They wanted more people in the country, and, said he, " we must pay for it, and what better inducement could we offer to the right kind of immigrant than to make agriculture in one of its varied phases possible. This is a rural industry upon which we have spent millions; still, we have something in return. We are the only country in the world that grows sugar by white labour, and do not forget that thousands of men, the sons of sugar planters, went and fought for this country. If Queensland had been a country in which sugar was grown by black labour, we could not have drawn on those splendid men. These phases go to the root of our national being." Proceeding, the Prime Minister stated that he could say that they were able to buy sugar from the Queensland grower at a lower price than that at which it could be obtained anywhere else, and but for this agreement the consumers would have been exploited, and would have had to pay 8d. or 9d. per lb. He hoped that one of the results would be that, after the coming season, they would never be compelled to import sugar from anywhere else. On the 25th of March he told the House that, owing to the high price of imported sugar, the Government was losing £20,000 daily at a retail price of 3½d. per lb., and the price would now be 6d. per lb. retail, while the wholesale rate would be £49 per ton, less 5 per cent. to purchasers. The retail price would allow the grocers 15 per cent. on the turnover or 18 per cent. on the cost, and he considered they were being treated very fairly, seeing they also were not being charged for bags and sacks. The restrictions were now removed from buying direct from the C.S.R. Co. He stressed the point that the increase was not due to the new agreement, but to the shortage which necessitated 100,000 tons being imported this year, while next year further gaps between supply and demand were expected, which would no doubt be stopped by the encouragement given by the new agreement. Mr. TUDOR (leader of the Labour party) stated that it was monstrous to raise the price of sugar to 6d., pointing out that this increase meant £6,577,000 out of the pockets of the consumers, to which Mr. HUGHES interjected, " the price may be altered if the world's price drops." Mr. McWILLIAMS (of Tasmania) put in a strong protest on behalf of the jam-makers of his State, stating that the increase meant ruin to that industry and disaster to the fruit growers. (This gentleman conveniently forgot that Tasmanian and other jam-makers would still be getting cheaper sugar than their competitors in Britain and other countries, and Mr. TUDOR also failed to mention that the major portion of the increased cost of production goes into the pockets of the A.W.U., always staunch supporters of the Labour party throughout Australia.) The PRIME MINISTER, in reply, said no member of the House had the courage to condemn the agreement with the Queensland Government; if foreign sugar came down the local price would fall, all the profits of the deal went in the encouragement of one of Australia's greatest industries; and he concluded by courageously challenging the members who did not like the agreement to vote against it and take the responsibility.

The new agreement has been received with jubilation by the Queensland producers, and a decided fillip will be given the industry. The consumer in Australia is to be congratulated on a good bargain, seeing that the latest advices from England mention 1s. a lb. as the retail price, and also bearing in mind that the imports at present are costing the Australian Government £81 per ton. The signing of the agreement may be considered a triumph for Mr. HUGHES, as he has succeeded in welding together so many divergent opinions—a task which most people would not have dared to face. The profiteer is naturally striving to reap an undue profit on old stocks but the different Governments are keeping a pretty sharp eye on him, and already several of these gentry have been mulcted in fairly substantial amounts. The Victorian Press is raving about the so-called injustice to the Australian consumer, and the term "spoon feeding" is being freely bandied about. It is rather significant, however, that the Victorian Government, which owns the Maffra beet sugar factory, is selling its output of about 1500 tons at the full selling price of £49 per ton, a rise equal to £20 a ton. The Victorian Government were asked to put the Maffra output into the pool at £35 per ton, but "winked the other eye." The beet growers, who are not hampered by all sorts of awards like the Queensland growers, are therefore big gainers by the new agreement.

The report of the Royal Commission on the sugar industry, which was originally due on the 30th June, 1919, has at last been published, and following are the leading points, discussion of which may be postponed for the present:—The total area under sugar cane in Australia is estimated at 171,100 acres, of which 160,534 are in Queensland, the average for the five years ending 1918-19 being 174,535 for Queensland and New South Wales. The value of cane lands ready for cultivation is estimated at £31 15s. per acre, giving a capital value of £5,541,496, which with £5,000,000 as the value of the mills as going concerns, totals over 10½ millions sterling. Those engaged in the industry, including 6600 mill workers, are stated as numbering 22,000, though these are not constantly employed. No official record of the cost of production could be found, but it was "remarkable that the average of the data supplied indicated that the industry was being carried on at a loss; but an examination of the statements submitted clearly indicated, with few exceptions, that the capital value was greatly inflated, that the receipts represented returns from a crop of average, and not of efficient, cultivation; that the average price of a ton of cane was understated, and that an unfavourable year was taken as an example. The weighted average price paid by the mills per ton of cane for 1917-18 was 32s. 6½d., the highest (paid by the C.S.R. Co.'s mills) 34s. 7½d., the lowest (by the Government central mills) 30s. 7½d." It was held that the average yield of cane could, by better methods of cultivation and use of suitable manures, be largely increased, as the average production was not satisfactory, though slowly improving. There was a want of organization in the supply of lime, and sulphate of ammonia should be used instead of being exported. The Governments should see that areas sold as sugar lands should be used for that purpose only for a number of years. Small use, the Commission states, is made of mechanical power in the cultivation of cane, and it is imperative that the raw sugar mills be placed under the direction and control of trained and competent hands. It gave special consideration to the disposal of by-products, especially molasses, but it does not appear that any useful decisions were come to. "Concessions to manufacturers in respect of preferential prices for sugar used in the manufacture of goods for export," says the report, "amount really to an export bounty. Manufacturers have been very fortunately situated, and the benefits they have derived have been very largely due to the policy which has made the sugar industry, as well as their own, the subject of fiscal assistance." The attitude of the financial institutions towards the industry, and their increasing reluctance to make advances, together with the reasons therefor, are dealt with, and will be referred to later. It was held that an increase from £21 to £22 per ton of raw sugar was justified; but actually the Federal Government has granted £30 6s. 8d.

Regarding the beet sugar industry in Victoria, the opinion is expressed that "there is no substantial indication that in the near future any important extension will take place in Australia," but it is recommended that control of both branches of the industry should be charged with the following responsibilities:—Industrial arbitration, efficiency in cultivation, price to be paid by millers for sugar cane, conditions under which cane may be delivered at the mills, efficiency of sugar mills, price for raw sugar to be paid to millers, recommendation of new areas suitable for cane cultivation and sites for mills, sugar experiment bureaux and stations. Recommendations concerning the control of the refining industry are also made. Regarding the position of the consumer in Australia at present, the report states that he "is in the fortunate position of obtaining sugar at the lowest price in the world. That this is still the case is due to the existence of the Australian sugar industry, and to the pro-vision of the Federal authorities in making early purchases of sugar abroad to an extent sufficient to supplement the Australian crop." Dealing with the fixing of wages and prices, the report states:—"Growers and millers emphatically claimed that the industry should be given stability as to wages and prices, which at present is lacking. The Commission is satisfied that this claim is reasonable, and that wages, cane prices, and the price of raw sugar should be fixed for a definite period of not less than three years." The Commission rejected—on the ground that "none of the commissioners should possess any personal interest, direct or indirect, in the industry"—the proposal put forward by the A.S.P.A. for representation of sugar producers on a tribunal which governs the industry's affairs to a large extent; but the report avers that "to unify the scattered functions now performed by State and Federal authorities, as well as to secure stability and efficiency, it is necessary to establish one controlling body, having statutory powers and a fixed tenure. A body, which might be called the Commonwealth Sugar Control, consisting of three commissioners would, in the opinion of the Commission, be most suitable."

Brisbane, 17th April, 1920.

Congress has sanctioned the increase of the appropriation provided for investigations on problems connected with sugar carried on by the Bureau of Standards, Washington, D.C., U.S.A. This increase amounts to 50 per cent., making $30,000 the amount available for this branch of the Bureau. Recently this Department has been active in standardizing saccharimeters, quartz plates, and accessory apparatus; in investigating problems connected with the manufacture of polariscopes; in establishing the 100° point of the saccharimeter; in fixing constants for the so-called "rare sugars" used in bacteriological work; in compiling tables for use in the sugar laboratory; as well as in several other directions. The work of the Bureau is highly regarded in every country concerned with sugar manufacture.

The International Saccharimetric Normal Weight Question.

A Committee has been appointed by the British Empire Sugar Research Association to consider the proposal urged by the American chemists to adopt an international normal weight of 20 grms. for use with the quartz compensating polarimeter for sugar work. This committee consists of Prof. A. R. Ling (who is chairman), and Messrs. L. J. de Whalley, Hugh Main, W. Douglas, and J. P. Ogilvie. Mr. W. H. Giffard is acting as Secretary.

In order to elicit the opinion of British chemists in the matter, the following statement of the arguments *pro et contra* the proposal was drawn up,[1] and copies have been sent to different centres at home and in the sugar producing parts of the Empire:—

There are now two normal weights in common use for the quartz compensating saccharimeter, namely: (1) the modified German Ventzke value of 26·0 grms., adopted by the International Commission for Uniform Methods of Sugar Analysis in 1900; and (2) the French weight of 16·29 grms.

In preparing the modified Ventzke normal solution, 26·0 grms. of pure sucrose are dissolved in water, and the liquid made up to 100 metric c.c. at 20° C., which solution in a 200 mm. tube reads at 20° C. exactly 100 scale divisions, corresponding with 34·657±0·023 angular degrees with spectrally purified sodium light. The French solution contains 16·29 grms. of sucrose in 100 metric c.c. at 20° C.

Quite recently, Dr. C. A. Browne, of the New York Sugar Trade Laboratory, has drawn attention to the suggestion made by Sidersky and Pellet at the International Congress of Applied Chemistry of 1896, that a sugar scale with a normal weight of 20 grms. should be adopted. Among the advantages set forth by Dr. Browne in favour of this proposal are the following:—

(1) The 20 grm. scale, being a compromise between the German and the French scales, is free from all national bias.

(2) The results obtained with the 20 grm. normal weight are easily converted into percentages by multiplying by 5; whilst the results obtained by the German or French normal weights are not thus easily transformed.

(3) Aliquot portions of 50, 25, 20 and 5 c.c. of the 20 per cent. solution represent even gramme quantities (10, 5, 4, and 1 grm. respectively).

(4) The specific rotation of sucrose at a concentration of 20 grms. in 100 c.c. (18·62 per cent. by weight) is about the maximum; whilst it is perceptibly lower at concentrations above or below this amount.

(5) A 20 grm. normal weight is always available as a one piece unit in a set of analytical weights.

Another argument used by Dr. Browne and his colleagues in America for abandoning the 26·0 grm. weight is that the factor for conversion into circular degrees, namely 100 = 34·657, is inaccurate, it having been shown by Bates and Jackson[2] in 1916 that the true value is 34 620. Dr. Herzfeld, of Berlin, however, contends[3] that the reliability of the Bates and Jackson value is open to question, owing to the fact that the sucrose used by them may have contained a sufficient amount of invert sugar to affect the result. He points out that these American investigators failed to preclude the possibility of hydrolysis occurring during the concentration of the sugar solution for the crystallization of the sucrose employed. He holds that in order to avoid this possibility, the solution of sugar should have been rendered slightly alkaline. However, the matter of the determination of his constant is now *sub judice*.

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[1] See also *I.S.J.*, 1919, 85, 106, 128, 408, 463, 520, and 621.

[2] *I.S.J.*, 1917, 380. [3] *I.S.J.*, 1919, 520.

The International Saccharimetric Normal Weight Question.

A number of chemists in the United States, Hawaii, Porto Rico, Philippines, and Cuba, have expressed themselves in favour of the adoption of the new standard; whilst in France the Association des Chimistes de Sucrerie has decided "to support Dr. Browne in accomplishing the adoption of the 20 grm. weight."

On the other hand, there are some who consider, for several reasons, that the present standard should be retained in use. Mr. F. Bates, of the U.S. Bureau of Standards, Washington, for example, is strongly opposed to Dr. Browne's proposal. His arguments, and those of others of the same view, may be summarized as follows:—

(1) The 26·0 grm. standard is already in universal use, excepting in France and Mauritius.

(2) Its rejection would necessitate the re-standardizing of all saccharimeters now in use, involving the re-cutting of the quartz wedges, and the re-calibration of the scale. This is a matter which probably would be very difficult to carry into operation, and might prove as costly as buying a new instrument.

(3) The adoption of a new standard would demand the re-compilation of the tables correlating the specific gravity, polarization, and sucrose percentage at present in use, and references in literature to "normal weight" would be confusing. Moreover, the standard quartz plates at present employed would be rendered useless.

(4) The accuracy of results would be diminished, for two reasons: (*a*) because a smaller weight of sample would be employed; and (*b*) because in an instrument in which the 26 gram scale were changed to the 20 grm. scale, the divisions would necessarily be smaller.

(5) Unless Great Britain and her Colonies, Central Europe, South America and Java, and *all* other countries agree to accept the new standard, the international situation in regard to comparative tests would be rendered difficult and uncertain.

British chemists who may not have received copies of the above statement are requested to write Mr. W. H. Giffard, Secretary of the British Empire Sugar Research Association, 3, 5, and 7, Old Queen St., Westminster, London, S.W. 1, stating their opinion as fully as possible, especially in regard to the following questions: (1) Which form of saccharimeter, and what normal weight do you employ? (2) Do you advocate the retention of the present international solution containing 26·0 grms. of sucrose in 100 metric c.c. at 20° C.? If so, kindly state reasons. (3) Or are you in favour of the proposal to employ a 20 grm. normal weight as a new international standard? If so, why? (4) Or do you favour the adoption of the French normal weight of 16·29 grms? Those responding are requested to state any other views they may have on the subject.

The Argentine sugar crop which started at the end of May holds out very promising prospects, as the Government have just removed the prohibition of exportation for at least 90 days, and that means that the sugar producers will get at least 100,000 tons of their excess crop of sugar out of the country, thereby stabilizing their home market.

One of the problems recently taken up by the Bureau of Standards for the information of table syrup makers is the determination of the maximum density to which a mixture of sucrose and invert sugar may be concentrated without risk of the occurrence of crystallization. A solution of sucrose alone is saturated when it contains 66-68 per cent., but such a solution is too thin for a commercial product, besides which it is susceptible to fermentation. If of a higher density, crystals are deposited. It is, however, well known that in the presence of invert sugar the density may be considerably increased without risk of granulation, though the amount of invert sugar must not be carried too far, owing to the comparatively low solubility of the dextrose. A study of the relative solubility of sucrose, dextrose and levulose has been made by chemists attached to the Bureau, and it was established that a syrup containing 33·7 per cent. of sucrose and 44·8 per cent. of invert sugar has the maximum solubility. It is possible to increase this concentration to a slight supersaturation without danger, and such a syrup is sufficiently dense for a good commercial product, while it resists the growth of micro-organisms.

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[1] *Facts about Sugar*, 1920, **10**, No. 24, 470-471.

Some Formulae for Sugar House Control.

By NOËL DEERR.

A number of years ago[1] I gave the expression $s(j-m)/j(s-m)$ = *available sugar*, where s, j, m are the purities respectively of the product (raw sugar), of the finally purified product whence crystallization begins (syrup), and of the by-product (molasses).

This expression is equally applicable to a refining process, in which case j is the value for the raw sugar or rather for this material after purification by passage over the char, s is unity, the value for sucrose when white refined sugar alone is made, and m as before is the value for the by-product, or barrel syrup in the vernacular of the refinery.

As shown in a later publication,[2] for exactitude these ratios must be determined with reference to sucrose as opposed to polarization, and in uniform concentration of non-sugar when gravity or refractive purities are used as opposed to absolute purities.

This one basic expression may be readily transposed into a number of other forms which may be used to solve certain problems that arise in the control of sugar houses. These expressions are collected below.

1. $s(j-m)/j(s-m)$ = sucrose in product per 1 sucrose in initial material.
2. $(j-m)/j(1-m)$ = product = sucrose in product = dry substance in product per 1 sucrose in initial material, when referred to sucrose as product.
3. $m(s-j)/j(s-m)$ = sucrose in by-product per 1 sucrose in initial material.
4. $m(1-j)/j(1-m)$ = sucrose in by-product per 1 sucrose in initial material, when referred to sucrose as product.
5. $(j-m)/(s-m)$ = dry substance in product per 1 dry substance in initial material.
6. $(j-m)/(1-m)$ = product = dry substance in product = sucrose in product when referred to sucrose as product.
7. $(s-j)/(s-m)$ = dry substance in by-product per 1 dry substance in initial material.
8. $(1-j)/(1-m)$ = dry substance in by-product per 1 dry substance in initial material when referred to sucrose as product.
9. $(s-j)/(j-m)$ = dry substance in by-product per 1 dry substance in product.
10. $(1-j)/(j-m)$ = dry substance in by-product per 1 product, per 1 dry substance in product, per 1 sucrose in product when referred to sucrose as product.
11. $m(s-j)/s(j-m)$ = sucrose in by-product per 1 sucrose in product.
12. $m(1-j)/(j-m)$ = sucrose in by-product per 1 product, per 1 dry substance in product, per 1 sucrose in product when referred to sucrose as product.
13. Again, if p = sucrose in initial material, then, referred to sucrose as the product, $p(j-m)/j(1-m)$ = product = dry substance in product = sucrose in product per 1 initial material; or conversely and more conveniently
14. $\frac{\text{Non-sugar in initial material}}{\text{Non-sugar in by-product}}$ = by-product per 1 initial material.

Further, if s_1 and s_2 be purities of the product, then

15. $\frac{\text{Sucrose in raw sugar of } s_1 \text{ purity}}{\text{Sucrose in raw sugar of } s_2 \text{ purity}} = \frac{s_1(s_2-m)}{s_2(s_1-m)}$; that is to say, the relative

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[1] *I.S.J.*, 1906, 243.

[2] *I.S.J.*, 1915, 360, 407, 460, 514.

quantities of sucrose obtained in raw sugars of different purities are independent of the purity of the initial material.

16. Finally, if $s\,(j - m)\;/\;j\,(s - m)$ raw sugar obtained from a juice be refined, there will be obtained $\frac{s\,(j - m)}{j\,(s - m)} \times \frac{s - m}{s\,(1 - m)} = \frac{j - m}{j\,(1 - m)}$ the same quantity as indicated as obtained in one process from the juice. Hence, the amount of sucrose as such obtainable from a raw juice is independent of the number of operations and of the purities of the intermediate products. This deduction, however, demands that m is invariable throughout the processes.

A few examples of problems soluble by the use of the expressions collected above are appended:—

1. What are the comparative weights of raw sugar of composition a, 96·0 per cent. sucrose, 96·3 gravity purity, and b, 97·0 per cent. sucrose, 97·2 gravity purity, as obtainable from a juice of any purity affording molasses of 40 gravity purity?

From Expression *15* the relative quantities of sucrose in the sugars are: $\frac{\text{sucrose at } 96{\cdot}3}{\text{sucrose at } 97{\cdot}2} = \frac{96{\cdot}3\,(97{\cdot}2 - 40)}{97{\cdot}2\,(96{\cdot}3 - 40)} = 1{\cdot}0066$, and the relative weights of the products are as $1{\cdot}0066 \times \frac{97}{96} : 1 = 1{\cdot}0171 : 1$.

2. What weight of dry substance will appear in molasses of 40 gravity purity as obtained from 100 tons of juice of 18° Brix and 84° gravity purity from which sugar of 97 gravity purity is extracted?

From Expression *7* the answer is: $18 \times \frac{97 - 84}{97 - 40} = 4{\cdot}10$, and from this result passage may at once be made to the gallons or cubic feet of the material in the condition in which it is actually produced.

3. 1000 tons of a low grade sugar of composition 90 per cent. sucrose, 92 absolute purity, are to be re-melted and produced as a higher grade sugar of analysis 96·3 per cent. sucrose, 97·3 absolute purity. What quantity will result?

Let the waste molasses obtained be of 45 absolute purity. Then from Expression *1* the recovery of sucrose will be $1000 \times \frac{90}{100} \times \frac{97{\cdot}3\,(92 - 45)}{92{\cdot}0\,(97{\cdot}3 - 45)} =$ 855 tons, and the weight of material obtained will be $\frac{855 \times 100}{96{\cdot}3} = 888$ tons.

The American Sugar Refining Company is building a new sugar refinery in Baltimore, which is expected to cost at least $8,000,000.

The S. S. HEPWORTH COMPANY, the well known makers of centrifugal machines, have appointed Mr. C. A. OLCOTT as their general manager with Mr. E. F. BABBITT as assistant manager.

A Board of Trade Report on the condition of industry in Saxony asserts that the sugar factories there are going into liquidation, on account of the lack of raw material, shortage of coal, strikes, and the short hours of work, in some cases workmen refusing to work for more than five hours a day.

In the account of the Java Sugar Crop for 1919 written by Dr. H. C. PRINSEN GEERLIGS, which appeared in our June issue, the table on page 325 showing the Sugar Exports for five years, only gave the figures for 11 months as regards 1919-20. The figures for the whole twelve months have now come to hand and show a total of 1,338,277 tons, as compared with the 1,308,049 tons for 11 months. The extra exports have gone chiefly to British India, Japan, and Australia.

The Argentine Sugar Industry.

A Few Brief Notes on its Origin and Development.

By ARTHUR H. ROSENFELD.

The sugar industry of Argentina should next year celebrate its centenary, since it is now just ninety-nine years since Father JOSÉ EUSEBIO COLOMBRES installed the first "sugar factory" in Tucumán. The whole development of the industry from 1821 to 1858, when the incipient industry really began to take on form, is due to the efforts of Father COLOMBRES—one of the same family, be it said in passing, that is still prominently identified with the Tucumán sugar industry.

In that epoch which was sponsored by the protecting shadow of Father COLOMBRES the cane was ground by passing it through a system of three vertical rolls made from one of the abundant hardwoods of the region, these rolls being turned by bulls. The primitive methods of manufacture are too well known to students of sugar matters to warrant a discussion here. Suffice it to say that, with such inferior extraction of juice, the yield of sugar on cane ground was, naturally, painfully low.

According to DU GRATY, in 1855 the Province of Tucumán produced 345 metric tons of sugar, while that of Salta, which was just going in for sugar, manufactured 57½ tons. At that time Jujuy had not commenced cane growing and the Chaco was an unknown wilderness, those 400 tons representing the entire sugar production of the Argentine Republic for that year.

In 1857 there were some fifteen "factories" in these two provinces and MOUSSY calculated the production of the industry at 720 tons of sugar and 70,000 gallons of rum. He stated that the industry was developing rapidly at that time and this is evident from the almost doubled production in the short space of two years.

In 1872 GRAMILLO calculated Tucumán's production at 1378 tons of sugar, Salta probably producing another hundred or so in that year. By 1876 the production of sugar in Argentina had reached around 3000 tons annually. In that year the Central Cordoba Railway reached Tucumán and the whole industry immediately became transformed—almost, it might be said, overnight. Distances were shortened—haulage was made cheaper—new markets were opened up. Machinery, which before had to be hauled from Rosario or Santa Fé with bulls, at a freight cost frequently equal to the value of the machinery and with four to eight months' expenditure of time, could now be shipped up from Buenos Aires in a few days and at a small fraction of the former expense. From the arrival of the first railroad (Tucumán now has three distinct lines) can be dated the disappearance of the old red *quebracho* mills and the abandonment of the rudimentary and expensive methods of manufacture. The year 1876, therefore, is a red letter one in the history of Argentina's sugar industry, for in it the modern industry was born.

In 1881, according to statements in an album compiled by a commission of residents of Tucumán for the Continental Exposition in Buenos Aires, the sugar production of that province had already reached 9000 to 9600 tons annually. The total production of the Republic in that year was probably around 10,000 tons, as compared with the 3000 tons produced in 1876. According to LATZINA, the national production was 24,750 tons in 1887 and CARRASCO calculated that of 1889 at 49,322 tons. This latter estimate is probably too high, however, as FLEISS, in his interesting report on "The Agricultural and Live Stock Production of the Argentine Republic for 1891," makes the following distribution of the crop of that year:—

TABLE I.

ARGENTINE SUGAR INDUSTRY IN 1891.

PROVINCE.	NO OF FACTORIES.	HECTARES CANE.	METRIC TONS. CANE GROUND.	METRIC TONS. SUGAR PROD.
Tucumán	34	21,881	669,682	40,217
Santiago del Estero	5	516	13,200	660
Salta	1	475	2,300	161
Jujuy	2	1,095	25,924	1,701
Missiones	2	1,709	4,500	338
Chaco and Formosa	2		5,113	296
	46	25,676	720,719	43,373

Cane produced per Hectare .. .. 28 Metric Tons (of 2207 lbs.)
Sugar produced per Hectare .. .. 1689 Kilograms.
Yield of Sugar on Weight of Cane .. 6·02 per cent.

From this it will be seen that in 1891 there were seven provinces producing sugar, although FLIESS said in that year that three factories out of the five in Santiago del Estero were not working. To-day that province does not figure among the sugar producers, nor does the territory of Missiones. Formosa still has one tiny factory and the Chaco one large one—"Les Palmas del Chaco Austral." Salta has one small factory and Jujuy two large and one small ones, while in Tucumán twenty-seven factories ground the crop of 1919, one of these—"La Invernada," a tiny place belonging to the Berho estate—having recently gone bankrupt but arranging to work the crop of 1920.

Protection.—We have now studied the development of the industry up to 1890, the year of Argentina's last great financial and political crisis, and from that year dates what we might designate as the intromission of politics into the industry.

Up to 1885, in which year the national production reached some 40,000 metric tons of sugar, little or no Argentine sugar reached Buenos Aires, which then paid for sugars imported from France and Holland anywhere from 3d. to 6d. per lb. The Tucumán sugar went to Cuyo, Catamarca and Córdoba—some by railroad and some on muleback. Then it needed no protection. The Federal Government permitted the importation of sugar with a 25 per cent *ad valorem* duty, this situation being maintained until 1890, when the duty on sugar was raised, the only benefit, however, being for the public income, as local sugar had all the markets it could supply.

In 1890 sugar was selling at from 6d. to 8d. per lb. in Buenos Aires, when Minister LOPEZ, of the protectionist school, presented in that "epoch of anguish," (as Deputy MELITÓN CAMANO of Tucumán recently expressed it in an address before the National Chamber of Deputies) "the internal revenue project and levied taxes on everything he had ever seen or heard of, having consoling words for all and happy promises for the future. He levied taxes on wines, matches, tobacco and also on sugar, along with the rest." Naturally, with such prices in Buenos Aires the sugar people of Tucumán, Salta and Jujuy could see a great future before them and began to enormously increase their plantations. Already in 1891 FLIESS tells us that the national industry contributed 77 per cent. of the sugar consumed in the country. It developed in an extraordinary manner and the Government was in receipt of a large income.

Then in 1900 came the industrial competition in the Buenos Aires port and here the troubles of the inhabitants of Tucumán, Salta and Jujuy began. Far from being a purely industrial conflict, it was a commercial war. The sugar manufacturers of the Argentine Republic were primitive men compared to the heads of the old established industries of Europe, far from experts in the business world, woefully lacking in the economic and scientific preparation possessed by their competitors in such a large degree. The labourers were the most ordinary class of field hands, incapable of competing with the skilled labourers that served the European manufacturers, anxious to reconquer a market which they had let slip through their fingers. As CAMANO put it, "the result of the engagement between the Argentines and those European eagles of production is well known. It is evident that they dominated us in any form that they desired. They had to reconquer these markets and the Deputies know the measures that European commerce employs when it wishes to reconquer a market; they produce articles at such a low price that they swamp the producers of the coveted market. That is what happened to our sugar industry."

This situation lasted some fifteen years. Then indeed the men who had invested their all in the Argentine sugar industry, encouraged to do so by the Government itself, began to solicit protection. The discussions in Congress stretched over a long period, but sugar may be said to have been protected but fourteen years, since the sugar industry has been in virtually a free trade condition since Minister PEREZ authorized the free introduction of 100,000 tons some six or seven years ago. At that time the sugar industry stopped enjoying the privileges of the Saavedra Lamas Law, which was not yet dictated, and of all other protective laws. The result is shown by the following table, taken from the February, 1920, issue of the *Revista Azucarera* of Buenos Aires.

TABLE II.

ARGENTINE SUGAR IMPORTATIONS FROM 1912 TO 1919. METRIC TONS.

YEAR.	UNDER FULL DUTY.		UNDER REDUCED DUTY.		DUTY FREE.		TOTAL.
	Refined.	Unrefined.	Refined.	Unrefined.	Refined	Unrefined.	
1912	11,044	19,033					30,077
1913	9,867	2,982	40,026	22,507			75,382
1914	6,353	156					6,509
1915	22	1					23
1916	7	1			15,056	15,262	30,326
1917			49,764	4,586	99,063	6,744	160,157
1918	1,097	61			30,318	1,793	33,269
1919	33	48			72,400	9,161	81,642
Total	28,423	22,282	89,790	27,093	216,837	32,960	417,385
By Class	50,705		116,883		249,797		
Per cent. Total	12·15		28		59·85		

Cane Varieties.—Another epochal date in the history of the Argentine sugar industry is the year 1910, when the Tucumán Agricultural Experiment Station began its work. For several years previous to that year "native" cane of the country—Cheribon purple and striped—had been showing great fallings-off in yields and the Agricultural Experiment Station was established with the objects of determining the cause of this phenomenon and encountering a remedy. That institution was remarkably successful in its efforts and prompt in its results. Several years of experimentation on a vast scale with some three hundred varieties of cane from all over the world definitely proved that the "native" cane of Tucumán was rapidly degenerating to suicidal yields and that two varieties from Java—the P.O.J. 36 and P.O.J. 213—could safely be depended upon not only to replace these "native" canes but to double their average yields in field and factory. By 1916, when the record-breaking series of frosts commenced which in three successive years were to practically wipe out the Cheribon, enough cane of these varieties was growing to rapidly replant the entire province with them, this process having been practically completed the past year with the almost complete disappearance of the "native" cane. The result was plainly seen in 1919, when the factories ground an average of 191 days from a decreased acreage, against a normally good grinding season of 150 days, and yet were compelled to leave thousands of acres of these canes in the fields when they stopped milling in December.

Production.—We have studied the beginnings of the production of sugar in 1821 and followed its development up to 1890, the year of the great Argentine crisis. Table III gives the production of sugar in the Argentine Republic from 1891 to the present day:—

TABLE III.

ARGENTINE SUGAR PRODUCTION.

YEAR.	MET. TONS.	YEAR.	MET. TONS.	YEAR.	MET. TONS.	YEAR	MET. TONS
1891 ..	46,366	1896 ..	163,000	1901 ..	158,154	1906 ..	116,287
1892 ..	57,696	1897 ..	111,616*	1902 ..	123,081	1907 ..	109,445*
1893 ..	62,000	1898 ..	75,538*	1903 ..	142,895	1908 ..	161,688
1894 ..	85,000	1899 ..	90,268*	1904 ..	128,104	1909 ..	127,322
1895 ..	130,000	1900 ..	117,209*	1905 ..	137,343	1910 ..	148,509
5 yrs. Avg.	381,062		557,631		689,577		663,251

YEAR.	MET. TONS.	YEAR.	MET. TONS
1911 ..	180,092	1916 ..	84,069*
1912 ..	147,249	1917 ..	88,075*
1913 ..	276,140	1918 ..	126,520*
1914 ..	335,956	1919 ..	298,000
1915 ..	149,299	Avg 4 yrs.	596,664
5 yrs. Avg.	1,088,736		

* Signifies winters of very severe early frosts.

Sugar Prices.—The average wholesale selling price of refined sugar, less 5 per cent. for cash, in Buenos Aires has been:—1896 to 1900, 36·3 centavos; 1901 to 1905, 29·9 centavos; 1906 to 1910, 35·2 centavos; 1911 to 1915, 33·5 centavos; and 1916 to 1919, 55·1 centavos, all per kilogram. The Argentine paper centavo is implied, the normal rate of exchange of which is $11·40 per £ sterling.

Importation and Exportation.—Table IV gives the metric tons of sugar imported into and exported from the Argentine Republic from 1895 to 1919, according to data furnished by the Director General of Rural Economy and Statistics of the National Department of Agriculture:—

TABLE IV.

FOREIGN SUGAR TRADE.

YEAR.	IMPORTED.	EXPORTED.	YEAR	IMPORTED.	EXPORTED.
1895 ..	5,651 ..	83	1908 ..	41,487 ..	18
1896 ..	2,073 ..	32,026	1909 ..	19,760 ..	40
1897 ..	946 ..	41,733	1910 ..	56,823 ..	—
1898 ..	440 ..	20,819	1911 ..	51,902 ..	—
1899 ..	456 ..	26,701	1912 ..	30,076 ..	103
1900 ..	458 ..	15,270	1913 ..	75,582 ..	60
1901 ..	279 ..	49,413	1914 ..	6,510 ..	64,690
1902 ..	155 ..	41,694	1915 ..	23 ..	53,823
1903 ..	132 ..	30,340	1916 ..	30,326 ..	404
1904 ..	147 ..	18,311	1917 ..	160,158 ..	24
1905 ..	149 ..	2,199	1918 ..	62,495 ..	23
1906 ..	1,553 ..	106	1919 ..	50,490 ..	—
1907 ..	43,522 ..	64			
			25 years..	641,593	397,944

A considerable amount of alcohol is produced in Tucumán, the quantity varying according to the price which rules. For the last ten years the average amount has been 9,200,000 litres (2,024,000 gallons) per annum, fluctuating between 14,038,065 litres in 1913 and 5,444,065 litres in 1917. At present high grade rectified alcohol is selling at the factory stills at about 6d. per gallon, duties for account of purchaser. The duty is about 8s. per gallon.

Capital and Horse-power Employed.—Definite data regarding the capital invested in the Argentine sugar industry are not available, but, taking fairly safe figures for the Province of Tucumán alone at $165,000,000 Argentine paper, we will not be exaggerating if we put the total capital in the national industry at twenty million pounds sterling.

As to the power developed in the factories, a publication of the Central Córdoba Ry Company gives the following distribution for the Tucumán factories alone:—

TABLE V.

HORSE-POWER EMPLOYED IN TUCUMÁN FACTORIES.

FORM.	H.P.	FORM.	H.P.	FORM.	H.P.
Steam	44,240	Animal	800	Naphtha	389
Electricity	2,115	Hydraulic	520	Crude Petroleum	66
				Total	48,130

Labour.—The same album publishes the following distribution of labour employed in Tucumán sugar estates:—Regular labourers on Tucumán estates, 37,018; Additional labourers brought in for crop, 24,821; Grand Total, 61,839. These peons earn annually more or less £1,650,000.

Up to 1917 the workmen in the factories made about 4s. per day and worked in two shifts of 12 hours each. In 1918 some advances were made and, beginning with the 1919 crop, a daily wage of about 6s. was established as the minimum for an eight-hour shift. The contract and piece work in the factories and fields, cartmen, foremen, etc., are now remunerated in the same proportion. For cutting and stripping cane 2s. was formerly about the average price per ton—the 1920 crop begins at 5s. The workmen all have free houses, and in some factories, such as Santa Ana for instance, fuel, medical, drug store and hospital service are furnished gratis, all workmen receiving one-half of their daily wage while sick and being well recompensed in case of accidents, which are very few. The San Pablo factory, belonging to NOUGUÉS BROTHERS, has recently completed the construction of a splendidly equipped hospital and public baths for the peons. All factories furnish buildings for abundant schools, and a great many now have accident insurance for their workmen. The LEACHES' "La Esperanza" factory in Jujuy employs two doctors, one of whom is one of the best known in the Republic, who conduct extensive scientific investigations of the diseases of that section.

Cultivation.—Most of the cultivation is still done with spade and plough, the people taking very slowly indeed to improved methods, although the advantage and economy of these have been amply demonstrated on a large scale on the Santa Ana and Lules estates of Hileret & Co. by the author, and on a small scale by the Experiment Station. For planting, the land is generally well broken and crossed with share ploughs and two harrowings given, except in newly cleared land, where the furrows are made with spades and most of the cultivation for the first year given with machetes. The rows are then indicated at six feet six inches with wooden ploughs which are wonderfully managed by the specialists in this class of work (*senaladores*), deepened with two passings of a share plough and then opened up definitely with a double mouldboard plough. The cane is planted in two continuous rows and covered with spades, the furrows remaining well below the surface of the ground when covered, for convenient irrigation. Early in spring the dirt is knocked off the cane with spades, the middles broken out with two furrows of a mouldboard plough and, after a weeding of the rows with spades when needed, the first dirt is thrown to the plants with ploughs and then the work finished off with spades, in order to smooth off the rows, get the dirt well in between the plants, etc. Then the middles are generally kept clean with reversible disc harrows, one of the few modern implements generally adopted in the Argentine sugar section, and the rows weeded with spades until the cane is ready to close, when the layby is made with spades.

With the ratoons the middles are broken out early in Spring with two furrows of an ordinary share plough and the rows are very neatly off-barred in the same way. Then the dirt is knocked away from the stools with spades and the remainder of the cultivation is proceeded with in the same manner as outlined above for the plant.

Practically no artificial manuring is done.

Climate.—The Argentine sugar section is subtropical and mostly at a elevation of from 1000 to 1500 feet above sea level. It lies between 22½ and 27 degrees south latitude, occupying a position between the low fluvial and coast region and that from which rise the foothills of the Andes. The region is well watered by the affluents of the Bermejo and Salado rivers, although in some parts the water for irrigation is rather scarce. According to WALTER G. DAVIS, for many years the Director of the very efficient Argentine Meteorological Service, in his monumental work on "The Climate of the Argentine Republic," the mountains are the true wealth of this zone, showing their beneficent action by the interception of the aqueous vapour brought by the winds and its condensation, due to the cooling of the air as it rises to greater heights in passing over their summits. Thus they produce an increase of rainfall on the windward side with a corresponding scarcity on the leeward side, and, as the prevailing winds in this zone are from the north-east, the eastern slopes are more favoured with rain than the western. The period of highest barometric pressure falls in July and August and the lowest in December and January. The amplitude in variation decreases, as DAVIS points out, with increased elevation.

In this zone the variations of temperature are most marked—changes of as much as 30° C. (54° F.) sometimes occurring in a few hours. The normal diurnal variation shows widely separated extremes, due to the rapid radiation from the soil and the air dryness at these altitudes.

Statistical tables compiled down to 1907 show an extreme annual variation of 47·6° C. (85·7° F.) but since then much greater variations of temperature have been recorded—in the years 1917 and 1918. The following table gives the dates of unusual temperatures observed at the Santa Ana factory in Tucumân Province by the writer in those years:—

TABLE VI.

EXTREMES OF TEMPERATURE OBSERVED IN 1917-18.

Record Maximum	47° C. (116·6° F.) in the Shade	January 20th, 1917
Record Minimum	—8° (below) C. (17.6° F.) in the shade	July 10th, 1918

OTHER UNUSUAL MINIMUMS.

January 5th, 1917	8°	June 24th, 1918	—6° (below)
March 9th, 1918	5°	September 16th, 1918	—3° (below)
May 30th, 1917	—3° (below)	November 16th, 1917	6·5°

The extreme recorded annual variation in shade temperatures, therefore, is 55° C. (99° F.)

If such a tremendously high temperature is recorded in the shade, what amount of heat do the cane in the sun and the labourers working it have to stand? DAVIS answers this question with the following data, taken at Leaches' "La Esperanza" factory in the Province of Jujuy from 1896 to 1902 and in Tucumân for two years, the observations being obtained with black bulb thermometers placed ten inches above sod-covered soil and exposed on sunny days. These thermometers were of the maximum type, so that their readings represented the highest radiation temperatures experienced during the day. The monthly means of these values for the two series of observations are given in Table VII together with the *maximum* registered in each case.

TABLE VII.

SOLAR RADIATION IN DEGREES CENTIGRADE.

	Jujuy.		Tucuman.	
Month.	Mean Max. Solar T.	Absol. Max.	Mean Max. Sol. T.	Absol. Max.
January	67·8	79·0	68·8	75·0
February	64·9	75·0	67·6	77·0
March	58·8	73·0	66·3	72·3
April	51·9	77·5	62·0	72·5
May	47·6	60·0	54·7	62·5
June	43·0	61·0	48·2	55·0
July	45·9	62·0	51·3	60·0
August	49·5	64·0	54·8	61·0
September	54·5	70·0	58·6	66·5
October	61·0	76·0	62·3	71·0
November	64·0	76·5	68·2	74·4
December	66·7	77·0	66·5	76·0
Year	56·4	79·0	60·8	77·0

To any one who has ever attempted to put his foot into water at the maximum here recorded, which corresponds to almost 175° F., these figures will bring surprise and almost unbelief. It is probable, however, although there are no available recorded sun temperatures to confirm this statement, that on January 20th, 1917, the solar temperature was *above 180° F.!* Evidently plants are saved from complete drying out under these temperatures by the relatively high humidity of the air, which, in the sugar zone, is as follows for the distinct seasons: Summer, 66 per cent.; autumn, 72 per cent.; winter, 64 per cent.; spring, 59 per cent.; average, 65 per cent.

Rainfall.—The rainfall in the Tucumân district, while deficient for best results for sugar cane, is nevertheless so ideally distributed that practically all of the precipitation comes in the growing season, and the winters are practically rainless—an ideal condition for ripening up the cane, making it more resistant to early frosts, and for its uninterrupted harvesting. Hence the writer considers the 38½ inches in Tucumân more useful than the 60 inches of Louisiana, a large part of which falls in winter, when it is not needed by the cane and only serves to interrupt cropping operations. In Salta and Jujuy, however, the average annual rainfall is most decidedly deficient and the cane growers there have to resort normally to much more irrigation than those of Tucumân.

A sum of not less than £165,000 has been allotted by the directors of the Commercial Union Assurance Co. towards establishing a Chair of Bio-chemistry at Oxford; while the Department of Scientific and Industrial Research has offered £30,000 towards the same object.[1]

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[1] See also *I.S.J.*, 1920, 302.

Specification of a Steam Belt Calandria Pan.[1]

By HORACE JOHNSON.

Types of Vacuum Pans.—For many years the coil pan was the only type used in the Hawaiian Islands. The diameter and length of coils varied as well as the arrangement of the coils and the system of drainage. The most popular type was that having coils 4 in. in diam. and about 60 ft. long, which as a rule, made 2½ circuits of the pan, each circuit being spaced from 10 in. to 12 in. apart. Then came the Stade system of calandria with circulating baffles, which, on account of its rapid circulation, met with favour in some quarters; but its high cost as compared with the coil pan prevented it from becoming extremely popular. In later years both these types have been superseded by the steam belt calandria pan.

It has steel sides, bronze or c.i. tube sheets, copper tubes, usually 4 in. diam. and from 2 ft. to 3 ft. long, and a centre tube, 2 to 5 ft. diam., according to the size of the pan. Steam is admitted in two places at opposite sides of the pan and follows a distributing space about 5 in. wide between the shell of the calandria and the first row of tubes. From this space the steam is evenly admitted between the tubes all around the pan, which insures an even and quick circulation of the boiling liquid up through the tubes and down through the large centre well.

At first these pans met with much favour for boiling marketable sugar strikes, but were considered inferior to the coil pan for boiling low-grade strikes to grain, the chief defect alleged being that the calandria prevented the strike from being started low down in the pan. This objection, however, apparently does not generally hold true, for in many places the calandria pan is now being used successfully for low-grade work.

Better circulation, better drainage of condensed steam and non-condensible gases, the comparative ease with which repairs can be made and the heating surfaces kept clean, make this type of calandria pan so far superior to the coil type that but few of the latter are now being built. During the last few years 51 vacuum pans have been built in the Territory of Hawaii, every one being of the steam belt calandria type. The total capacity amounted to 48,000 cub. ft. with 46,000 sq. ft. heating surface.

In order to have a quick boiling pan with good circulation, experience shows that the ratio of capacity to heating surface should be 1 cub. ft. to 1 sq. ft. of heating surface in tubes not over 2 ft. 9 in. long. The best average length is 2 ft. 6 in. long. By having ample heating surface in tubes of this length, the pan will not only boil quickly, but it will have good circulation when boiling slowly with low pressure steam.

The following specification will cover the most important points in a well constructed calandria pan, designed to give a good circulation and proportioned correctly in regard to the ratio of heating surface to capacity, and graining capacity to total capacity, for producing a good quality of raw sugar. The specification is general and covers the sizes usually required in Hawaii.

Diameter and capacity.—One c.i. vacuum pan, A ft. in diam., having X sq. ft. of heating surface, calculated on the inside diam. of the copper tubes 4 in. diam., No. 14 gauge, 2 ft. 6 in. long between tube sheets, and having a working capacity of Y cub. ft. ($X/Y = 1$). The working capacity of the pan shall not be over 8 ft. above the top tube sheet of the calandria; and its graining capacity not over 28 per cent. of the total capacity of the pan.

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[1] Extracted from the Report of the Committee on Manufacturing Machinery, presented to the Hawaiian Sugar Planters' Association, 1919.

Steam Calandria.—The steam calandria shall be A ft. plus 8 in. diam., consisting of a steel plate belt, ½ in. thick, inside flanged, with bronze tube sheets ½ in. thick set at 27° angle with the horizontal. The centre tube is to be of c.i. and not less than $\sqrt{A}$ ft. in diam. The heating surface shall be copper tubes 4 in. diam. No. 14 gauge, by 2 ft. 6 in. between tube sheets in such number as to equal X sq. ft. of heating surface. The tubes are to be set perpendicular and not closer than 5¼ in. pitch. There shall be two steam inlets at opposite sides of the calandria, each having a diameter of 8 in. for 8 ft. pans to 12 in. for 12 ft. pans. Suitable baffles shall be placed opposite each inlet to baffle and turn the steam into the steam space between the wall of the calandria and the first row of tubes. This steam space shall not be less than 5 in. wide. A T-fitting with 90° angle valves, shall be furnished for each steam inlet having one branch for exhaust steam the same diameter as the inlet to the calandria, and the other branch for live steam having a diameter of 3 in. for an 8 ft. diam. pan to 5 in. for a 12 ft. pan. The calandria shall be drained by two brass pipes 2 in. diam. for 8 ft. pans to 3 in. diam. for 12 ft. pans at the bottom of the tube sheet close to the centre tube and opposite to each other. These drains shall lead through the bottom of the pan by means of stuffing boxes to traps, one for each drain. Check valves shall be placed on these lines before they enter the traps.

There shall be four bleeders in the calandria for non-condensible gases. Each shall be 1 in. diam. for 8 ft. pans to 2 in. diam. for 12 ft. pans. Two bleeders, on opposite sides, midway between the steam inlets shall bleed the top steam space around the tubes into the atmosphere. The other two, situated close to the centre tube and midway between the steam inlets, shall bleed the lowest part of the calandria by means of a perforated pipe extending from the top to within 6 in. of the bottom. These shall lead to the vapour pipe going to the condenser, or may be carried through the bottom of the pan to the water leg sump. All piping within the pan shall be of brass and controlled by suitable valves operated from the outside. The calandria shall be constructed and tested to stand a cold water pressure of 50 lbs. per sq. in.

Cone Bottom.—The bottom of the pan, A diam., shall be of c.i. 1¼ in. thick, with flanges 3½ in. by 1¼ in. thick. Four lugs shall be cast on the sides for supporting the pan at such centres and at such height as may be desired. The depth of the cone shall be sufficient to give the sides an angle of 35° to 37° with the horizontal. The discharge opening shall be 18 in. for 8 ft. diam. pans to 30 in. for 12 ft. pans.

Around the discharge opening there shall be cast an angular space for the admission of syrup, molasses and water. This space shall be separated from the interior of the pan by a perforated copper plate. On the outside it will be provided with connexions for a 4 in. syrup pipe, a 4 in. molasses pipe, a 4 in. washout pipe, and a 2 in. connexion for water and steam. Valves shall be furnished for these connexions, with extended stems and hand-wheels so that they may be easily operated from the pan floor.

As closely as possible to the bottom of the pan there shall be two seed or "cut over" inlets, one on each side. Each shall be 8 in. diam., for 8 ft. diam. pans to 12 in. diam., for 12 ft. diam. pans.

The discharge of the pan shall be fitted with a molasses-sealed, sliding gate valve operated by means of bevelled gears and hand wheel from the pan floor, or with a drop cone valve of the latest type also operated from the pan floor.

In the bottom of the cone there shall be a truncated cone-shaped baffle tube to turn or distribute the incoming syrup, molasses or water. The bottom diameter of the tube shall be 8 in. less than the diameter of the pan discharge. The top of the baffle shall be 6 in. greater than the diameter of the centre tube.

Belts.—There shall be two c.i. belts *A* ft. in diam. and 1½ in. thick, with flanges 3½ in. by 1¼ in. The total height of the two belts shall be 9 ft. or 1 ft. above the working capacity of the pan. The lower belt shall have a rectangular manhole, 16 in. wide by 27 in. high. The centre of the manhole shall be 22 in. above the lower flange. It will also carry a suitable proof stick placed as close as possible to the lower flange, and a bulb pocket to carry a 12 in. angle thermometer. There shall be a 1¼ in. steaming-out pipe around the inside of the pan 4 in. above the calandria and 3 in. from the wall of the belt. A valve and suitable connexion shall be provided for this pipe. The belts shall have two lines of 6 in. diam. sight glasses, off set, and in such numbers as to permit the operator to observe the level of the boiling massecuite at all heights. All sight glasses shall be fitted with ¼ in. brass spray pipes with individual valves.

Dome.—The dome of the pan is to be c.i., *A* ft. in diam., 1½ in. thick with flanges 3½ in. by 1¼ in. The height of the dome shall be 3 ft. 6 in. There shall be one 18 in. diam. manhole on the dome and also three sight glasses, 6 in. diam., placed equi-distant around the dome. The vapour outlet of the pan shall be approximately 26 in. diam. for 8 ft. diam. pans to 36 in diam. for 12 ft. pans.

Catch-alls or Traps.—The pan shall be provided with a suitable catch-all, either of the circular vertical plate type, situated on top of the pan, or of the Stillman type having 3 baffle plates with short off-set tubes in them, 2 in. in diam. In either case, the area of the vapour travel through the catch-all shall be at least 1½ times the area of the vapour outlet of the pan. Two 2 in. diam. drains shall be provided from the catch-all plates back to the pan.

There shall also be furnished: One 3 in. vacuum breaker valve, placed upon the dome of the pan or on the vapour pipe leading to the condenser, with an extension stem and hand wheel so that it may be easily operated from the pan floor. One 2 in. blow-off valve to be connected to the steam calandria and set to blow off at 25 lbs. One 12 in. diam. compound pressure gauge, ranging from 30 in. vacuum to 50 lbs. pressure, to be connected to the steam calandria midway between steam inlets. One 12 in. angle thermometer, with a range to 250° F. One mercury column vacuum gauge, complete with trap arrangement for collecting and draining the condensed steam from the connecting pipe. One so-called "acid connexion," either connected to the lower belt just above the calandria or to the upper part of the cone bottom with the necessary piping so that it may be used from the pan floor. Sufficient 85 per cent. magnesia block, 2 in. thick, to cover the calandria, belts and dome, and sufficient 85 per cent. magnesia cement to cover the cone bottom and catch-all; also sufficient wood lagging with suitable brass bands, to lag the belts and calandria.

In addition to the above equipment it is advisable to furnish each pan with a recording thermometer and a recording vacuum gauge. These instruments will indicate the regularity with which the pan is operated, the number of strikes taken off, the time of boiling, the conditions under which the boiling takes place and the time taken in discharging the pan or the time it was idle before starting another strike. Such means of control is well worth having.

Condensers.—The condenser most commonly used is the barometric counter current type wherein the vapour from the pans enters the condenser at the bottom section and travels upward through the falling cooling water, while the air and non-condensible gases are drawn out from the top of the condenser, and is distributed as it falls through the condenser by suitable baffles. The required size of capacity of a condenser may be calculated from the amount of vapour and the quantity of cooling water to be handled. Most manufacturers, however, furnish a condenser of such generous dimensions that the same condenser can handle the vapour from an 8 ft. or a 12 ft. diam. pan. An approximate guide for condenser dimensions is as follows:—

HEATING SURFACE PAN. SQ. FT.		DIAMETER.		DISTANCE BETWEEN VAPOUR INLET AND WATER INLET.
400	....	2 ft. 0 in.	....	4 ft. 0 in.
500 to 800	....	3 ft. 0 in.	....	6 ft. 0 in.
800 to 1200	....	4 ft. 0 in.	....	7 ft. 0 in.
1200 to 1400	....	5 ft. 0 in.	....	8 ft. 0 in.

The supply of cooling water should be provided at the rate of 1½ gals. per min. for each sq. ft. of heating surface.

Two types of baffles for distributing and dividing the cooling water are in common use. One consists of fire bar-grids through which the water passes and is thus finely divided; and the other consists of a series of baffle plates, so placed as to cause the water to fall or splash from one plate to the next. Both types give satisfactory results. The fire bar grids are apt to become clogged up when dirty water is used, while the baffle plate type does not have this disadvantage and less care need be put upon the cleanliness of the water supply. With suitable baffles, properly arranged, the temperature of the cooling water leaving the condenser should not be over 6° F. cooler than the temperature corresponding to the vacuum carried.

To facilitate the pan work and to make the entire system more flexible, the writer prefers to have a separate condenser for each pan, and to have all these condensers connected to a main condenser and central vacuum pump. There should also be a small auxiliary vacuum pump connected to all the pan condensers to create a vacuum in each pan before it is cut into the main system.

The main vacuum pump for the pan work should have a *net* displacement of 27 cub. ft. per min. for each 100 sq. ft. heating surface in the vacuum pans.

All the vacuum pans should be connected with a cut-over pipe of not less than 8 in. diam. Such an arrangement increases the capacity of the entire installation and is a great help in producing a large sized grain.

The use of seed massecuite as a basis for marketable sugar is now quite generally used in Hawaii. The storage tank or seed mixer for this massecuite is generally a small sized crystallizer, and should have a capacity of approximately one-half the capacity of the largest pan on the floor.

Required Capacity.—It is a well known fact that the time of boiling a marketable sugar strike with the object in view of obtaining a maximum recovery of large sized crystals will vary considerably with the quality of the juice handled. From practical experience in many factories which have to contend with a great variation in the purity and quality of juices, the writer has found that by providing a vacuum pan capacity of 55 cub. ft., for each ton of cane ground per hour, and one sq. ft. of heating surface in the pans for each cub. ft. of capacity, the vacuum pan equipment, in skilful hands, will be sufficient to cover all normal variations in the quality of juices encountered. Up to 50 tons cane per hour the vacuum pan equipment should be in three units of equal size and so arranged that any one pan may be used either for marketable sugar strikes or low grade work. For mills crushing more than 50 tons cane per hour it is preferable to increase the number of units to four or five.

Storage Tanks.—The supply tanks holding syrup and molasses for vacuum pan work should be equipped with perforated steam pipes in order to heat the liquor to the temperature of the boiling massecuite before it is taken into the pans. Too long heating at too high a temperature will cause a loss of sucrose and a decomposition of glucose which will impart a dark colour to the sugar. To control the heating it is advisable to equip all the supply tanks with thermometers.

There should be a separate pipe line for the syrup tanks to the pans and for the molasses supply tanks to the pans.' For easy operation it is well to have a storage capacity on the pan floor of 48 cub. ft., per ton of cane per hour for syrup, and the same capacity for molasses, each divided into three units for mills crushing up to 40 tons cane per hour and increasing the units as the capacity of the mill increases.

The following table giving the capacities of pans, condensers, vacuum pumps and storage tanks for mills crushing from 25 to 75 tons cane per hour is submitted for consideration :—

	Vacuum Pans.			Size of Condenser for each Pan.	
		Each having			
Tons of Cane per hour.	Number of Units.	Heating Surface, sq. ft.	Working Capacity, cub. ft.	Diameter, ft. in.	Distance between Vapour Inlet and Water Inlet, ft. in.
25	3	460	460	2 6	5 0
30	3	550	550	3 0	6 0
35	3	640	640	3 0	6 0
40	3	730	730	3 6	6 0
45	3	830	830	4 0	7 0
50	3	920	920	4 0	7 0
55	4	1010	1010	4 6	7 6
60	4	1100	1100	4 6	7 6
65	4	1190	1190	4 6	7 6
70	4	1280	1280	5 0	8 0
75	4	1380	1380	5 0	8 0

			Storage Tanks.			
			Syrup.		Molasses.	
Tons of Cane per hour.	Quantity of Water for each Condenser, galls. per minute, 75° F.	*Net* Displacement of Main Vacuum Pump for all Pans, cub.ft per minute.	No. of Units.	Capacity, cub ft.	No. of Units.	Capacity, cub. ft.
25	690	370	3	365	3	365
30	820	445	3	445	3	445
35	960	520	3	525	3	525
40	1090	590	3	600	3	600
45	1240	670	4	540	4	540
50	1380	745	4	600	4	600
55	1510	820	5	530	5	530
60	1650	895	5	585	5	585
65	1780	970	6	520	6	620
70	1920	1045	6	560	6	560
75	2070	1120	6	600	6	600

A White paper [Cmd. 752] giving a "Report on Industrial and Commercial Conditions in Germany at the close of the year 1919" sets forth the production of German sugar, in metric tons of raw, from 1913-14 to 1918-19 as follows :

1913/14	2,715,900	1916/17	1,546,900
1914/15	2,510,100	1917/18	1,564,000
1915/16	1,512,500	1918/19	1,335,600*

* Up to 31st July.

Recent Progress in Cutting, Loading, and Transporting Cane in Hawaii.[1]

By B. D. BALDWIN.

Since the last annual meeting,[2] nothing of great importance on this subject has developed. Now that peace has been declared in Europe, it is hoped that matters connected with it, for example loading machines, will again receive the attention of certain manufacturers, who have already given them considerable study.

Cutting.—No new cane harvester has been invented since the last and most promising cutting machine, viz., the Luce Cane Harvester, which was developed in Louisiana, and has been pronounced a success there and also in Cuba.

It was hoped that an improved machine of this type might be brought to Hawaii, but no new development of it has been introduced during the past year. As stated in one of last year's reports, the machine cannot be operated except under certain conditions, which do not exist in Hawaii.

The practice of burning for harvesting purposes is continually receiving more attention, and the majority of the plantations in the Territory now practise this method. In burned cane, one cutter is able to cut about three tons of cane more per day than in unburned cane; but even with burning the work is delayed at times to a considerable extent, on account of having to cut fire-breaks, which have to be prepared about every other day. As a rule it will take all the cane cutters the whole afternoon of every alternate day to prepare these fire-breaks for the next morning's burn.

It can therefore be readily seen that on a very small plantation the gain in burning for harvesting purposes will be offset to a considerable extent by cutting fire-breaks, as numerous small burns would be necessary in order to keep the cane from souring before it reached the factory. On large plantations, the burns are larger in area, and a relatively greater gain is accomplished by this method.

The object in touching on this subject is to suggest a method of laying out the fields in such a way that burning for harvesting purposes can be accomplished with less cutting for fire-breaks, thereby increasing the amount of cane cut by the cutters. For instance, if roads were made out in the direction of the prevailing winds, with one road to every 40 acres on a plantation that could handle a 20-acre burn, the cutting of the fire-breaks would be reduced by one-half, and the cutters would only be required to cut a fire-break for every other burn.

At first thought this would seem to be a waste of good land, but when it is taken into consideration that it is the practice on most large estates, at the present time, to lay out one 20-foot safety road to about every 80 acres, it would not mean such a great difference in the amount of land taken up by roads. If the roads through every 40 acres were only made 15 feet wide, it would amount to a 30-foot road instead of a 20-foot road to every 80 acres.

Under ordinary conditions, and where plantations can spare the land, it is certainly a wise proposition to make some provision along these lines, to assist the harvesting gangs. As the fire-break question for burning purposes is a large one, we should look for a machine that would cut, or partially cut these roads. The writer believes that it would be well worth the expense of the Association to import a Luce cane harvester from Louisiana, and try it on fire-breaks. Even if it only partially cuts the roads through the cane, it would be a great labour saver.

Loading.—On the majority of plantations, loading is still done by manual labour, but it is believed at this time that a practical loading machine is not far distant.

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[1] Summary of a Report presented to the Hawaiian Sugar Planters' Association, 1919.

[2] *I.S.J.*, 1918, 230.

It is the opinion of the writer that the Holt tractor company is working in the right direction, and will soon produce a satisfactory machine for loading cane, one that will suit conditions in Hawaii.

On some plantations on the Island of Hawaii, derricks with a hoist are being used in connexion with double sleds very successfully for loading cane on cars. Animals are employed to haul the sleds; but it is believed that small tractors could do the hauling to better advantage and for less cost. The Cleveland tractor is very adaptable for this kind of work, and could handle a much larger load than two mules could haul.

Until a successful loading machine is produced, the only resource is to make this work as easy as possible for the loaders. In loading cane by manual labour there does not seem to be any special knack in handling this work, as far as the men are concerned. This fact was brought out clearly at the *hapaiko* contest held at the last Territorial Fair in Honolulu. Men from widely different places participated. Maui, Oahu and Kauai were represented, but the method of loading was the same—it was simply a case of the strongest men winning.

In some cases portable tracks could be put closer together, making a shorter pack. This was done by one plantation on Maui during the influenza epidemic, and it helped to a considerable extent at that time. However, in this connexion there are cases when the iron carmen are just as important as loaders; and it would be impossible to lay portable tracks closer together (especially in hilly and stony country) and be able to keep ahead of the packers.

In conversation with a man from Cuba, it was stated that there are no loading difficulties in that country, as their cane cars are small, and it is not necessary for the loaders to climb a ladder to load them; the work can be done from the ground, their cars only being of a capacity of 2000 lbs against our 5000 or 6000 lbs. -

This statement leads one to believe that there are possibilities in this line which could be worked out advantageously. For instance, if these small cars were only used in the harvesting fields, and dumped on larger cars at a central station on the main line of railroad, the small cars could then be immediately returned to the loaders, and receive another load, and so on.

The loaders under these conditions would be able to load more cane and with less effort. Also lighter portable track could be used, and less grading would be required in the fields. The team work or hauling would be easier, and the small cars off the track would be easier to lift on again. It would of course mean a double system of cars.

General Transportation.—There have been a number of changes gradually creeping in during the past few years, which make for better efficiency and facilitate the transportation of our crops to a marked degree.

Portable tracks have been one of the most important items. From a 14 lb. rail used on most of the plantations a few years ago, the size of rail has now been increased to 20 lb. per yard. Strange to say, although a section of 20 lb. portable track means 91½ lb. more than the 14 lb. rail, the iron carmen seem to prefer the heavier rail, and find it easier and quicker to lay. Moreover, from a hauling standpoint, there is no comparison between a light and a heavy portable track. The cars go in and out of the fields with a great deal less trouble, and it is not often that they get off the track; while with a 14 lb. rail the work is continually being delayed, due to derailed cars. Also, fewer runaways take place on steep grades, due to the better gripping of the wheels to heavy portable track.

Caterpillar tractors are being used more and more in the harvesting fields, and are employed to a great advantage on the long uphill hauls, delivering the loaded cars from the portable tracks to the locomotives on the main line. These tractors are being used successfully to lower empty cars down steep grades, and to steady the loaded cars when being brought out of the fields with a down grade.

In the homestead district of Kalaheo, Kauai, cane has been planted in most inaccessible places, such as a patch on top of a high hill; on a steep side-hill; and again in the bottom of a deep valley, miles away from the main railroad with no available water for fluming purposes. Yet the McBryde Plantation put no restrictions on the homesteaders regarding the planting of these patches of cane. They have been able to handle such crops successfully with caterpillar tractors and trailer waggons of the low-body type.

Regarding the subject of flumes it may be mentioned that at Makaweli a few years ago we gave "Armco" iron a trial, and had ten portable sections made up into "V" flumes, with wooden jacks, each section being 10 ft. long; but the experiment was an absolute failure. We also tried it on steep grades, but without success. These iron flumes would not become slippery enough, and the cane would jam, even on the steepest grades.

The Milwaukee type of gasoline locomotive is being used successfully by two plantations on Kauai, for hauling cane to the mill, and sugar to the landing.

Autotrucks have now come into general use on most of the plantations on these Islands, and after once making general use of them one would be at a loss without them. It is a question now which kind of truck is the best to purchase, *i.e.*, the more expensive, or the more moderately priced one; also whether it should be of heavy or light tonnage. It has been the experience of some, that heavy trucks on ordinary plantation roads are very hard on tyres, the expense in this direction being rather startling. The wear on double tyres is a great deal more severe on rough roads than that on the single tyres, and it is a fact that single tyres will last double tyres three times. Therefore, it would seem that a two-ton truck with single tyres is the most economical for general plantation use.

Criticism of Patents on Motor Fuels containing Alcohol.[1]

By W. R. ORMANDY, D.Sc.

The only general deduction that one can draw with certainty from the patent applications of the past five years is the universal assumption that alcohol in some form or other will be a constituent of the motor fuel of the future. That ethyl alcohol could be used alone as a motor fuel has, of course, been recognized from the earliest days of motor production, but it was equally recognized that owing to the low thermal value of this material, and to its comparatively low vapour pressure, it was by no means ideal for the purpose. Certainly so long as the convenient volatile hydrocarbons of the paraffin series, known under the generic term of petrol, were available at a reasonable price, there was no necessity to encourage the use of either alcohol alone or in admixture with other bodies.

In 1913 patents were taken out for the utilization of mixtures of crude alcohols (produced by the fermentation of peat) with kerosene or the like bodies. It is particularly emphasized in 28,072 of 1913, that these alcohols or carbinols consist of the lower alcohols, mixed with fusel oil and similar bodies. This is important in view of claims which are made at a later date, and which will be referred to further on. Further, in this specification it is stated that the inventor (or should we say author) was aware that in 1870 it was proposed to mix hydrocarbon oil such as petrol with fusel oil and any of the oxides or hydrated oxides of the hydrocarbons for the preparation of an oil for illuminating purposes.

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[1] Extracted from a paper read before the Institution of Petroleum Technologists, London.

The patent is of interest, because it emphasizes the public character of the knowledge that ordinary commercial alcohol containing 5 to 10 per cent. of water can be caused to mix with paraffins and similar hydrocarbons in the presence of fusel oil or higher alcohols. I need hardly point out that it is a well known fact that the miscibility of alcohol and paraffin hydrocarbons is dominated by the presence or absence of a comparatively small amount of water in the alcohol; nevertheless patent No. 109,802 is granted for a claim to a mixture of anhydrous or substantially anhydrous alcohol with petrol as a fuel for motor engines. It is, I think, quite impossible to obtain a patent of this sort in Germany, because in that country the Patent Office is allowed to cite knowledge contained in well known text-books and technical literature, as well as information embodied in previous specifications, in contesting the issue of a patent. It does not seem to me that there is much invention or discovery in the substance of this patent. The fact is perfectly well known that anhydrous alcohol and petrol will mix, and it is equally obvious that a mixture of this fuel will burn in an internal-combustion engine.

Some proposed mixtures.—This question of miscibility of alcohol and paraffin hydrocarbons again arises in patent No. 109,806. The patentee points out that a desirable fuel would be a mixture of paraffin oil, petrol and alcohol, meaning thereby commercial alcohol of approximately 95 strength volume per cent. He points out that such alcohol will not mix with paraffin and petrol or admixtures of these, but that it can be caused to do so by making use of what he calls a mixing or combining agent, which he says must be something which is soluble in both constituents of the proposed mixture. As an illustration, he instances that anhydrous fusel oil or anhydrous amyl alcohol will cause such admixture to take place, citing as an example :—2 volumes of paraffin oil; one volume of petrol; one volume 95 per cent. alcohol; and 4 volumes of fusel oil or amyl alcohol. This patent was granted subject to a reference to certain prior patents in pursuance of section 7, sub-section 4, of the Patents and Designs Act of 1907. Among those are 28,072 of 1913 and 2515 of 1914. One of these has already been dealt with, being the patent for the admixture of mixed alcohols (from peat fermentation) containing fusel oil with paraffin.

No. 2515 of 1914, which is also cited, comes within another category. It is the type of patent which adds to the gaiety of an otherwise sombre publication. The fuel which this patentee proposes to employ consists of :—3½ litres of petroleum boiling from 150-270° C.; ½ litre of petroleum boiling from 110-150° C.; ½ litre of petroleum boiling between 110-150° C.; plus 200 c.c. of 96 per cent. alcohol; plus 2 c.c. of ethyl ether; plus 1 c.c. petroleum ether; to which may be added ½ litre of benzol and ½ litre of naphthalene.

The subject matter of 134,766 is closely related to that of 109,806. Here again it is recognized that commercial alcohol and petroleum distillates do not mix, and although the earlier patent claims the use of any mixture of combining agent which is miscible in each of the above-named constituents, nevertheless the later patent claims the use of a compound containing the acid radicle of any hydroxy fatty acid adapted to blend the other constituents; in other words, the later patent, instead of using amyl alcohol or fusel oil, uses another class of chemical compound to perform the same service.

The subject matter of 136,452 taken out by the same patentee as the last patent herein referred to is again closely related to the earlier patent of 109,806 for a fuel made up of gasolene, kerosene and ethyl alcohol, in which the alcohol is caused to mix with the other constituents by adding the acids obtained from linseed oils as a mixing or combining agent.

Such, then, appears to be the history of comparatively recent work on the admixture of alcohol with the paraffins, and the means employed to bring about such admixtures, as established by the Patent Office records.

Alcohol and ethyl ether.—The fact that alcohol, particularly in cold weather, has a low vapour pressure, has led to attempts to mix with the alcohol bodies which would increase the vapour tension. We have dealt above with the proposal to admix the volatile paraffins, and now turn to the efforts which have been made in the direction of the employment of ethyl ether.

In 2515 of 1914 it was proposed to add 2 c.c. of ether to something like 5 litres of a complex mixture. That this can be of any practical importance would seem unlikely, but in 21,316 of 1914 considerable quantities of ether are employed, the claim being for a fuel for internal-combustion engines, consisting of a mixture of alcohol and ethyl ether in the proportions of 86 parts by volume of alcohol to 10 parts by volume of ether together, if necessary, with denaturing agents. That alcohol and ether will mix perfectly in all proportions is, of course, well known.

"*Natalite*" *fuel.*—In 24,262 of 1914, the claim is made "that alcohol cannot be said to be improved as a fuel for use in ordinary type of carburetters for motor cars or aircraft by the addition of ether, until the latter amounts to 40 per cent. by weight of the mixture." It further states that the improvement continues up to the addition of 60 per cent. by weight of ether, claiming the best all-round results for a mixture of equal parts by weight. This forms the first claim of the patent. A further claim is for the addition of a ½ per cent. of ammonia, which is stated to overcome the tendency that alcohol-ether fuel is said to have, namely, to cause corrosion in the engine, especially to the valves and cylinder. The fuel made under this specification, which has been used to a considerable extent in South Africa, is known as "Natalite." In a later specification the same inventor claims the use of trimethylamine in the place of ammonia for the prevention of corrosion.

We have seen that in the two last specifications referred to, the main claim was for admixture of alcohol and ether with the ether varying from 40 to 60 per cent. In 123,450 a claim is made for alcohol and ether in much the same proportion, but with the addition of 5 to 30 per cent. of kerosene together with denaturants if required. In this case the ether is added partly as the mixing or combining agent referred to in 109,806 so as to cause the petroleum and the alcohol to combine, but also to give the necessary vapour tension to the mixture.

The later application, 133,434, consists of an admixture of ether and alcohol with 5 to 50 per cent. of any suitable distilled hydrocarbon oil. The patentee describes a method for making an ether-alcohol mixture by passing alcohol vapour through sulphuric acid in the ordinary manner, and mixing the condensate, which consists of alcohol and ether, with further alcohol, instead of stating a definite proportion of ether to alcohol.

Admixture with gases.—The patentee of 103,720 claims that by passing kerosene under high pressure through narrow interstices in the presence of a gas containing hydrogen or a hydrocarbon gas between a specified range of temperature, the gas is caused to combine with the paraffins, producing a fuel having a higher vapour tension than the original paraffin. Patents 104,330, 105,256, 107,217, and 111,933 also deal with the admixture of gas with hydrocarbons.

No. 112,741 is a claim for the use of alcohol saturated with acetylene as a suitable fuel for motor-car engines. Alcohol is distilled, and the vapour mixed with acetylene gas and the mixed vapours condensed. It is claimed that this gives a good saturation with the gas.

The extraordinary tendency which the specification 111,933 indicates of hydrogen or hydrocarbon gases tending to combine with saturated and inert chemical bodies in the cold is made use of more fully in patent 119,066. Bodies such as petroleum, resin oils, etc., are subjected to a pressure in the cold in the presence of such bodies as hydrogen, coal-gas, pintsch gas, and indeed, at one stage at a temperature of 15° below zero, acetylene is introduced at a pressure of 12 atmospheres, and thereafter the pressure is removed. Either the gas is present as a supersaturated solution, or it has entered into combination, that is, if it remains in the liquid.

The patentee of 120,792 claims saturating alcohol with acetylene by bubbling the gas through the liquid, and claims the addition of 1 per cent. of acrolein as a denaturant. This later addition would appear to be the novelty in this invention.

Risks involved.—In connexion with the above described patents, it is interesting to note that the use of such gases as acetylene merely mechanically dissolved in stable liquid fuels was seriously considered by the Inter-Departmental Committee on the Production and Utilization of Alcohol for Power Purposes. It was considered that the danger attached to the use of such solutions was too great, as a mechanically-dissolved gas is given off very readily, and would make the storage and handling of such liquids exceedingly dangerous.

General.—We have seen that patents have been granted for admixture of bodies which every chemist knows will mix, and which every engineer knows will drive an internal-combustion engine. Between the years 1900 and 1910, I tried all sorts of mixtures of fuels, including petrols, paraffins, benzol, light solvent naphtha, methylated spirits, and ether. Many of the patents which have been referred to are certainly not inventions or discoveries. They are granted, I suppose, because the patent records of the past fifty years cannot show that anything of the sort has previously been patented. It is public knowledge to anyone skilled in the art in question that such liquids as paraffin, petrol, benzol, alcohol, ether, acetone, will either mix in any proportion, or in restricted proportions, and that by admixture for example of petrol with benzol a certain amount of alcohol can be caused to dissolve in the mixture which would not dissolve in the petrol alone. It is equally common knowledge to chemists and engineers that any admixture of two or more volatile fuel bodies will result in a third substance also capable of being used as fuel.

It is not my intention to express any pronounced opinion upon any of the specifications; but it is surely time that the Patent Office ceased to grant patents for admixtures of every conceivable burnable organic liquid which might possibly be used as a motor-fuel. We shall no doubt be having in the near future patent applications for admixtures of benzol and petrol though they have been used and sold for years, and with like certainty we shall have alcohol in admixture with benzol and petrol with and without ether, and the possible utilization of acetone will also be claimed. The fact, of course, is that any admixture of liquid hydrocarbon which can be vaporized by the modern carburetter, or volatilized by means of some form of pre-heater, such as is used in a paraffin carburetter, can be employed as a motor-fuel, and improvements in carburetters will continue to be made which will allow of the less volatile products being used in increasingly large quantities. It is a distinct danger alike to the motor user, the motor manufacturer, and the general community that such patents should be granted.

Publications Received.

Sugar: A Simple Treatise on Beet Sugar Manufacture. By Allen R. Kahn. Third Edition revised by Le Roy S. Weatherby. (U.S. Sugar Publications Co., 108, West Second Street, Los Angeles, Cal. U.S.A.) 1920. Price: $1·50, net.

This is a booklet of 56 pages dealing in an elementary way with the subject of sugar and its manufacture from the beet. It opens with a brief discussion of the chemical composition of sugar, and its value as an article of food; and in these chapters the authors treat very fairly the question of cane *vs.* beet sugar, quoting two recently published articles by recognized authorities[1] in support of their views. A description of "the making of sugar" follows, after which the reader is taken a "tour of a complete sugar plant." There is a chapter defining a number of the technical terms in common use, and an explanation of some of the formulæ applied in chemical control, while two diagrams show the various stages followed in American houses, producing white granulated with the recovery of the sugar remaining in the molasses by the Steffen process. This small treatise of Messrs. Kahn and Weatherby should prove of value to the general reader desiring to acquire some insight into the beet sugar industry. It is written in simple language, and obviously the authors have taken a good deal of care in stating the salient facts clearly, concisely and accurately.

Efficient Boiler Management. Chas. F. Wade, A.M.I.E.E. (Longmans, Green & Co., London and New York) 1920. Price: 12s. 6d., net.

A number of books have been published dealing with boilers and their accessories; while there also exist excellent treatises upon the chemistry of combustion, and the analysis of fuel gases. Neither of these classes of literature, however, deals to any extent with the practical application of the scientific principles of boiler and furnace management, and it is with the object of filling this gap that this book has been written. It discusses in their proper sequence the elementary scientific principles underlying steam raising, and devotes particular attention to the practical application of these principles, so as to obtain the most efficient results. Among the chapters of special interest may be mentioned that dealing with the performance of boilers, in which directions are given for carrying out a boiler test, and for tabulating and interpreting the data obtained; that discussing the examination of a boiler installation for defects and losses; and lastly that considering in general terms the organization and equipment of a modern boiler plant. A book such as this, which throughout reflects considerable practical experience, should be appreciated by sugar factory engineers.

Industrial Alcohol. By W. E. Cross. Bulletin No. 10, Department of Industrial Investigation, University of Tucumán, Argentina. 1920.

Dr. CROSS' 84-page pamphlet in Spanish contains a considerable amount of valuable information dealing with the question of the production and application of industrial alcohol. He has collected a quantity of data relating to the manufacture and denaturing of spirit which should prove of particular interest to those who at the present time are studying this important question; and one may express regret that the booklet is not available in English, in order that the results of his investigations on the matter might be available to a larger circle of readers.

Some Lepidopterous Pests New to Sugar Cane in Queensland. Edmund Jarvis. Bulletin No. 9, Division of Entomology; Bureau of Sugar Experiment Stations, Queensland.

These notes record the presence in North Queensland cane fields of a few Lepidoptera not included in Bulletin No. 3 of the Division of Entomology,

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[1] *I.S.J.*, 1919, 227, 619.

Brisbane, these being as follows: *Cirphis loreyi* Dup.; *Mocis frugalis* F.; *Melanitis leda* Linn.; *Padraona hypomoloma* Lower; "Bag-moth," *Anthela acuta* Walker; and *Ophiusa melicerte* Drury. In addition to describing the early life stages, a list is given of a number of Lepidoptera allied to those under consideration that affect cane elsewhere, among which is mentioned the "Pink Borer," considered by D'EMMEREZ DE CHARMOY the most harmful borer in Mauritius, into which it was introduced in cane stalks. About 60 of the 82 species of the Lepidoptera listed by KIRKALDY[1] belong to the Bombylidae, Noctuidae, Pyralidae and Tineidae, the remainder being scattered among 11 other families; but comparatively recently 10 Australian species have been listed, while possibly an additional 30 might easily find a place in the fauna of cane fields. In all probability the total number of moths and butterflies at present recorded as associated prejudicially with cane will be found to fall little short of 100 species.

(1) **Soil Alkali.** F. S. Harris. Circular No. 41. (2) **A Study of Methods of determining Soil Alkali.** D. W. Pittman. Bulletin No. 170. Utah Agricultural College Experiment Station, Logan, Utah. 1920.

We have received a copy of Messrs. HENRY TATE & SONS Ltd's now familiar coloured Chart showing the imports of refined and raw sugar into the United Kingdom; total of all kinds, and proportion of refined each year; the import per head each year; the lowest and highest prices of Tates' Cubes duty paid, and 88 per cent. Beetroot f.o.b. and cane raw sugar; and alterations in duties. During 1919 Tates' Cubes touched 72s. per cwt. The Customs scale of duty on sugars entering the U.K. is given very conveniently, showing the changes since the duty was re-imposed in 1901; and there is a short table showing important dates in the recent history of the British sugar industry. We understand that a copy will be sent gratis on application to Messrs. HENRY TATE & SONS, Ltd., Mincing Lane, London, or Exchange Place, Liverpool.

American Commerce Reports.[2]

THE HONGKONG SUGAR TRADE.

For the first time in a good many years Hongkong imported refined sugar in material quantities during 1919. The sugar situation during the whole of the year was exceptional. The high prices ruling in producing centres led Chinese buyers in the colony in the earlier months of the year to hold off for lower prices. When, as the season developed, it appeared that still higher prices were to be anticipated there was a wave of wild speculation of such a character that, for a time, spot raw sugar on the Hongkong market was quoted at higher prices than refined sugar could then be purchased for.

The Hongkong refineries handled a smaller volume of sugar than usual but handled what they did under very profitable and satisfactory conditions. A considerable share of the refined product was sent to Europe, the Near East, and India, with the result that the current shortage was felt all the more in the China trade. Nevertheless on the year's trading China as usual took the immensely larger portion of the colony's output of refined sugar as well as of raw sugar.

The total inports of sugar during the year are placed at 403,733 short tons, compared with imports of 485,530 short tons in 1918. As in the previous year Java furnished the larger portion. The imports from the Philippines were smaller in 1919 than in 1918, the demand for Philippine sugar from the United States taking Philippine stocks out of the market here. The imports in detail for the two years were as follows :

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[1] Bulletin No. 8, Division of Entomology, Hawaii, 1909.

[2] Culled from "Commerce Reports," published by the Department of Commerce, Washington. In many cases these are abbreviated here.

Imported from	1918			1919		
	— Raw.	Refined.	Candied and Molasses.	Raw.	Refined.	Candied and Molasses.
	Short tons.	Short tons.	Short tons.	Short tons.	Short tons.	Short tons.
Dutch East Indies	338,376	—	—	282,444	11,792	*a* 11,657
Philippine Islands	96,172	—	—	56,745	—	—
China	24,882	—	*a* 218	18,920	—	—
Indo-China	1,320	—	—	9,865	—	—
Straits Settlements	13,270	—	*b* 10,904 *a* 239	3,251	624	*b* 6,803
Other countries	149	—	—	1,142	356	*a* 134
Total	474,169	..	11,361	372,367	12,772	18,594

a Molasses. *b* Candied.

The exports of refined sugar to Europe during the year were much above those of 1918, but were in fact considerably below what had been anticipated. India took a larger share of the refined product than heretofore and Egypt and Mesopotamia were good customers. The exports in detail were as follows :

Exported to—	1918			1919		
	Raw.	Refined.	Candied and Molasses.	Raw.	Refined.	Candied and Molasses.
	Short tons.	Short tons.	Short tons.	Short tons.	Short tons.	Short tons.
China	61,826	285,413	*a* 16,332 *b* 4,392	89,424	146,459	*a* 11,712 *b* 15,959
Great Britain	—	1,899	*b* 10	—	11,207	—
Japan	—	—	—	22,090	9,370	*b* 477
India	14	25,063	*a* 301 *b* 8	—	28,177	—
Indo-China	—	—	—	—	2,333	—
Siberia	—	—	—	—	1,389	—
Near East	—	—	—	—	6,694	—
Other Europe	—	—	—	—	3,555	—
United States	24	491	*a* 23 *b* 10	—	540	—
Africa	—	8,317	—	—	—	—
Central and South America	—	7,161	—	—	—	—
Other Asia	254	5,861	*a* 231	—	—	—
Other countries	2	21	*a* 11	753	435	*b* 15
Total	62,120	334,226	21,318	112,267	210,159	28,163

a Candied. *b* Molasses.

The total exports for the year amounted to 350,589 short tons, as compared with exports of 417,664 short tons in 1918. Stocks on hand at the end of the year were smaller than they have been for a good many years. [Consular Report, April, 1920].

At the Cunagua Central, Cuba, in which double crushers are in use,[1] the rate of grinding for the entire crop was 129·6 tons per hour with a maceration of 7·4 per cent. The average sucrose extraction was 94·08 per cent. sucrose in the cane, and the normal juice extraction, 80·63. The yield was 11·78 and the recovery 91·58 per cent. The oil and wood consumption figures were 0·25 and 0·52 per cent. cane respectively.

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[1] *I.S.J.*, 1919, 406,471.

Review of Current Technical Literature.[1]

ADVANTAGES OF THE ELECTRIFICATION OF CANE MILLS, PARTICULARLY IN CUBA.

Charles Griffith. South African Sugar Journal, 1920, 4, No. 4, 331–335.

It has been demonstrated, particularly in Cuba, that power can be generated from a large steam turbine, transformed through an electric generator, transmitted to motors, and transferred to mechanical work at the driven machine more efficiently than by means of a large number of small steam engines and steam pumps. Moreover, motor-driven machinery generally costs less; it can be more advantageously placed; and it is smaller and lighter than steam-driven plant. *Decreased amount of steam.*—The amount of steam required per H.P. in a steam cylinder operating by throttle control or non-expansively between the limits of pressure common in sugar mills ranges from 75 to 100 lbs.; whereas the amount required by a Curtis steam turbine operating expansively between the same pressures is about half the lower figure stated, and can be further decreased by higher steam pressures and superheat, to which the steam turbine is eminently suited. Conservative estimates of the radiation of heat in the pipe lines, etc., of a cane mill show that the loss from this source alone may account for 20 per cent. of the fuel bill.

Saving in labour.—In normal times the labour item varied from 4 to 10 per cent. of the total cost of the sugar, depending upon the country concerned, and present conditions make the reduction of this cost very desirable. After computing the wages chargeable to the attendants of steam and electric motor-driven mills respectively, it was estimated that in the case of electric plant the labour concerned in manufacturing and maintenance would be £8 per day less when 1100 bags of sugar (325 lbs. each) were produced per day, that is, a reduction of 1s. per ton. Actually the force could be reduced by 26 men, and this extended also to the clerical staff in the general office. *Reduction of supplies.*—Electric motors and centrifugal pumps consisting only of revolving elements mounted in oil ring type bearings require a very small amount of oil; and pump packings surrounding the rotating shafts last a long time, this condition relating also to the steam turbines and generators in the power-house, which have a similar oiling system. On the other hand, in the steam-driven mill the oil runs from the bearings or is carried off by the exhaust steam, thus becoming a source of trouble, either by collecting on the engine, the pump, or the floor, or else by being carried into the steam-heated coils and calandria. In an electrically-driven mill, the oil returns to the oil wells of the pump and motor bearings, and is once more used on the shafts, so that it lubricates over and over again. Exhaust steam is entirely free from oil. Oil, grease, packing, waste, pipe coverings, and the replacement of worn parts in a steam-driven mill may cost 2s. 4d. per ton of sugar; whereas in an elecrically-driven factory at least one-third of this is saved.

Greater continuity of service.—Electric drive has won the reputation of being the more reliable means of power application, and there are many cases of continuous operation of electric motors for periods of several years without a shut-down. In a cane mill the majority of interruptions are from slipping of the rolls and repairs necessary to the steam engines and steam pumps. By electric motor-drive the shut-down periods due to slipping can be practically eliminated through the indications of the power meters of the individual motors, and by a re-adjustment of the relative speeds of adjacent sets of rolls they can be made to take their proper division of the load, thus preventing slipping. *Cheaper pumping of fresh water.*—The unit cost of water at an electrically-driven mill is low owing to the decreased cost of pumping, in comparison with the usual conditions obtaining in the case of the steam-driven plant. No boiler plant is required at the pumping station, as the power can be transmitted over line from the mill. *Economy in the repair shops.*—While machine shops are commonly located in the mill building, the carpenter shops are usually in a separate building, having its own boiler plant. Under electric drive the power expenses of both shops are decreased; tools can be started up at any time; and power is consumed only while they are in operation.

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[1] This Review is copyright, and no part of it may be reproduced without permission.—(Editor, *I.S.J.*)

In the case of fuel, labour, supplies, and repairs, it is possible fairly accurately to determine the money value of the economies effected by the adoption of electric drive in respect of these items; but in regard to other sources of saving, such as increased yield, shut-downs, pumping supply water, certain assumptions must be made. Other possible sources of economy, moreover, concerned with the repair shops, transport, and administration, depend so much on local conditions that it is not feasible to appraise them. Below is given a table summarizing the various items on a basis of the average Cuban mill producing 102 tons of sugar per day, or 15,900 tons in a crop of 156 days. If only the interest on the added investment is considered, the net saving per year increases the net profits by a large amount. It will be seen that the average savings (which are stated in £ sterling) are such as to pay for the cost of changing over an existing mill in a very short time.

	STEAM.	ELECTRIC.	SAVING.
Fuel (additional to bagasse)	2,485	—	2,485
Labour (manufacturing)	8,944	8,229	715
Supplies	1,854	1,225	629
Repairs	5,665	5,367	298
Shut-down (labour)	123	—	123
Water supply (and miscellaneous)	475	—	475
			£4,725
Increased yield (maceration)			6,625
Total reduction per year			£11,350
Reduced cost, per ton sugar			14s.

TWO-MASSECUITE SYSTEM OF BOILING. *R. C. Pitcairn. Facts about Sugar, 1920, 10, No. 12, 230-231.*

A method of boiling, in which two massecuites are handled, which has been adopted in Hawaii in a 1000-ton plant, is outlined. The purity of the first is brought to 72 to 73°, so as to yield a good 96° sugar (requiring only a little water to give this polarization), while the purity of the resulting molasses is 48 to 50°. In boiling the low-grade pan, the proportions of molasses and melted sugar, or of molasses and syrup, are so adjusted to give a massecuite having a purity of about 50°, from which it is possible to obtain molasses having about 30° purity. It is often desirable to boil a low-grade seed massecuite, parts of which can be used as footing for another low-grade pan. This can be built up and completed by the addition of molasses, in which case the low-grade seed massecuite can be formed at 52 to 54° purity, or even higher, additional molasses being used to complete the massecuite and reduce the purity to about 50°. After the first footing has become concentrated to a point at which the crystals begin to appear (or just before this point), the steam is shut off, when the grain immediately appears. The massecuite will keep in motion for about three hours, during which time it slowly cools, and the grain grows evenly. The crystals are then further enlarged by starting the steam to put the massecuite into motion, and drawing in sufficient water to change the concentration of the mother-liquor and its relationship to the crystals. After the crystals assume the required size (either with or preferably without the use of water), the pan can be built up by intermittent feeds of water and molasses together, the grain continuing to grow till the pan is full. Regarding the temperature to be carried, 140°F. (60°C.) is considered desirable, cooling slowly to 130°F. (54°C.) before dropping; and if crystallizers are in operation, the concentration should be brought to a heavy density, say 98-99° Brix. After machining, a molasses of 30° should be obtained. This sugar can be used as seed or remelt as desired; if as seed for the 96° sugar, a sufficient quantity is taken into the high-grade pan, built up with the necessary amount of remelt and syrup to give a massecuite having a purity of 72 to 73° and dropped at 93 to 94° Brix.[1]

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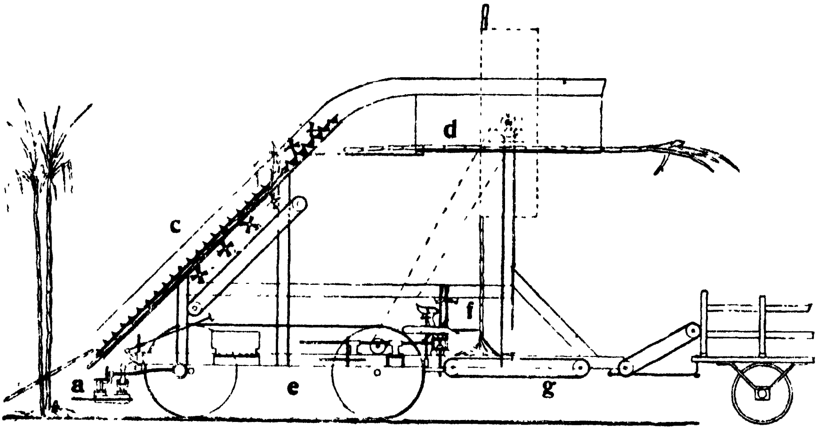
[1] See also *I.S.J.*, 1919, 88-89.

Review of Current Technical Literature.

THE "VICTOR" CANE CUTTER AND TOPPER. *Anon.* *South African Sugar Journal, 1920, 4, No. 2, 115-117.*

It consists of a light type of caterpillar tractor *e*, the engine of which besides propelling the whole apparatus also drives the two cutting saws *a* and the topping circular knife *f*. These circular saws are driven by two flexible shafts, and always adjust themselves automatically to the contour of the ground The depth of cut of the saws is regulated by the trend of the tractor, so that should it work in soft soil, and sink, say, ½ in , the saws would cut just below the level of the ground, and in hard soil right on the level ground. In the case of an obstruction in the field, such as a large stone, the driver of the tractor can at any time raise the two saws. Protruding in front of the knives are two endless revolving chains to which are attached steel hooks, and any cane lying down is picked up by this means and drawn towards the saws.



After the cane has been cut, it travels upward on the elevator *c*, and during its course is trashed by means of revolving steel brushes. When it arrives at the top, it is deposited in the trough *d*. When this trough is full, it is tipped into a vertical position (as shown in dotted outline), so that the tops of the cane are lowermost. By means of many experiments, it was proved that the tops bend over at the junction of the "glucose and sucrose portions" of the cane. All the stalks thus become level, and are cut through by the topping knife *f*, which can be raised or lowered to any desired position, an operation that requires no skill and can be done by a native. Lastly, the cane is thrown over upon the conveyor *g*, which passes it to the wagon in the rear. In this way cane can be cut, trashed, topped, and loaded with but two men in attendance. About 2 acres per day can be covered, depending upon the contour of the ground and the speed at which the machine can travel. A small company has been formed to enable the inventor to improve and exploit his cutter and topper, which, according to Mr. JOHN MURRAY, M.I.Mech.E., consulting sugar engineer, is "in advance of anything that has been invented."

IODOMETRIC METHOD FOR THE DETERMINATION OF REDUCING SUGARS. *H. van Nouhuijs.* *Archief voor de Suikerindustrie in Nederlandsch-Indie, 1920, 28, No. 17, 591-595.*

In the iodometric method described by SCHOORL,[1] the amount of copper remaining in the unreduced Fehling's solution is determined by adding potassium iodide, acidifying, and titrating the liberated iodide with standard thiosulphate. It is now pointed out that there is a mistake in the directions given in TERVOOREN and GEERLIGS' "Handboek" for carrying out this method,[2] the quantity of sulphuric acid stated being too small. It should be operated in the following way: 30 grms. of the molasses (or other product in proportionate amount according to the reducing sugars present) are clarified with 25 c.c. of 30 per cent. normal lead acetate solution, made up to 500 c.c., and filtered; 100 c.c. of the filtrate are treated in a 500 c.c. flask with sufficient sodium phosphate solution to throw down all the lead and calcium present, made up to the mark, and filtered. Now 50 c.c. of this clarified liquid and 50 c.c. of Fehling's solution are boiled together in an Erlenmeyer flask in the manner prescribed by Herzfeld, the reaction checked by the addition of 100 c.c. of cold water (recently boiled), and the whole cooled; 7·5 grms. of potassium iodide and 25 c.c. of 25 per cent. sulphuric acid are successively added, and the free iodine immediately titrated with N/10 thiosulphate. At the same time a blank determination is made, using 50 c.c. of Fehling's solution without the addition of any sugar, the difference between the two titrations in c.c. of N/10 thio multiplied by 6·3 giving the mgrm. of copper (Cu) separated in the form of cuprous oxide, from which figure the percentage of reducing sugars is calculated. This method was carefully compared by the author with that in which the cuprous oxide precipitated is filtered off, dissolved in an acidified solution of a ferric salt, and the ferrous salt formed titrated against standard permanganate.[1] Probably the results obtained by the iodometric procedure are a little too low; but it is a rapid method, and very convenient in practice.

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[1] *I.S.J.*. 1916, 334.

[2] Third edition, page 95-96.

Delicacy of the α-Naphthol Test for the Presence of Sucrose in Waste Waters.

M. Kauffman. Archief voor de Suikerindustrie in Nederlandsch-Indië, 1920, 28, No. 15, 515-519.

It is generally recognized that α-naphthol is a most useful reagent for ascertaining whether sucrose be present in the waters draining from juice-heaters, evaporators, pan coils, and condensers. It is pointed out, however, that the indication that may be given by the manner of applying it known as the ring test, may not always be reliable, for it has been repeatedly observed in different factories that it failed to indicate the presence of sucrose in the waste waters when it was known that a certain amount of entrainment had taken place. Generally this test is carried out in the following way, though a large number of modifications, in which the proportions and the manner of mixing are varied, have been described[2]: 2 c.c. of the water (after filtering, if necessary) contained in a test-tube are mixed with a couple of drops of a solution of α-naphthol in 95 per cent. alcohol, and 2 c.c. of concentrated sulphuric acid (chemically pure) are carefully poured down the side of the tube without allowing it to mix with the liquid, so that the acid owing to its greater gravity forms a layer beneath. If sucrose (or invert sugar) be present, a coloured zone forms at the point of contact between the two liquids. Another modification of this test is that known by the name of Skarblom,[3] according to which a test-tube (80 × 10 mm.; about 3½ × ½ in.) is filled with the water, then emptied, the drop of water left sufficing; then 1 or 2 drops of a 4 per cent. alcoholic solution of α-naphthol, and 15 to 20 drops of concentrated sulphuric acid, are added to the test-tube and shaken together. If a violet colour forms within 30 seconds, sugar is present in the water examined. A comparision of these two modifications was made, using a series of sugar solutions the content of which varied from 0·0005 to 0·05, and the following were some of the indications obtained:

Concentration.	0·05	0·03	0·015	0·005	0·00125	0·0005
Ring reaction.	Very distinct.	Fairly distinct.	None	None	None	None
Skärblom reaction.	Very distinct	Very distinct	Distinct	Distinct	Faint	Very faint.

It is clear from these results that the Skärblom modification is considerably more sensitive than the ring reaction. In fact, the latter failed to indicate in the case of concentrations of 0·010 and 0·015, which would mean appreciable "unknown losses" under average working conditions. Regarding the factors that control the delicacy of the ring reaction, it would appear that the intensity of the zone of colour is dependent to a large extent upon the manner in which the sulphuric acid is added. Thus, it is stated that if in the case of a concentration of 0·05 one adds the sulphuric acid very carefully, the ring may be only faint; whereas with solutions of much lower sugar content the colour may be very distinct if after the addition of the acid the test tube be shaken a little, or allowed to stand longer than usual; in other words, the ring test is made more sensitive by more closely approaching the conditions obtaining in the Skarblom reaction. With the purpose of ascertaining the effect of non-sugar substances on the sensitiveness of these two tests, different organic substances were added to sugar solutions of varying concentration, among which were formic, acetic, lactic, citric and oxalic acids, alcohol, acetone, phenol, and asparagin, while also tests were made with evaporator condensed water, and the distillate from acidified juice; but in no case could any detrimental effect on the α-naphthol reaction be detected. It is concluded that the ring test must be regarded as unsuitable, and that the Skarblom reaction should always be used, if possible as a quantitative determination, as was in fact suggested by HENRI PELLET.[1]

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[1] See *I.S.J.*, 1915, 236; 1919, 354.

[2] *Die deutsche Zuckerindustrie*, 13, 564; 17, 537. *Monatshefte für Chemie*, 7, 198.

[3] *Centralblatt fur die Zuckerindustrie*, 1903-1904, 163. *Die deutsche Zuckerindustrie*, 17, 419.

DETERMINATION OF REDUCING SUGARS BY THE VOLUMETRIC PERMANGANATE METHOD.

T. van der Linden. Archief voor de Suikerindustrie Nederlandsch-Indië, 1917, 25, 325-327.

In the volumetric method of determining sugars, sometimes known as Müller's (but better as Mohr and Bertrand's[2]), the cuprous oxide is dissolved in a solution of ferric salt containing sulphuric acid, and the ferrous salt thus formed determined by means of a standard solution of permanganate.[3] It has been stated by SCHOORL and REGENBOGEN[4] that an error may arise owing to the oxidation by the air of the acid solution of ferrous sulphate, results lower than the truth thus being obtained. Therefore, two series of experiments were made by the author, in which the reducing sugars in 50 c.c. of a clarified solution of cane molasses were determined under different conditions. In the first series, the cuprous oxide was dissolved in a solution of ferric salt containing sulphuric acid (that is, following the ordinary procedure); while in the second the solution of the cuprous oxide was effected in a neutral solution of a ferric salt, and the sulphuric acid added immediately before titration with permanganate.

No great difference was found between the results of the first and second series, though the average of the second was a little higher than the first. If, however, some time was allowed to elapse between the addition of the mixture of sulphuric acid and ferric salt and the titration with permanganate, the results were distinctly lower, oxidation having apparently taken place. On the other hand, if the cuprous oxide was dissolved in an approximately neutral solution of a ferric salt, a delay of 20 min. or so before titrating had no effect, provided the sulphuric acid were added immediately before the addition of the permanganate. Consequently, it is recommended that in the method under consideration an unacidified solution of ferric salt (ferric sulphate or ferric alum) be used for dissolving the cuprous oxide, the sulphuric acid being added directly before proceeding to the titration by means of permanganate.

EVALUATION OF HYDROSULPHITE.

G. Bruhns. Centralblatt fur die Zuckerindustrie, 1920, 28, No. 21, 445.

Hydrosulphite solutions are oxidized with great rapidity by atmospheric oxygen, which fact renders EKKER's method of titrating a solution of this salt with potassium ferricyanide (using ferrous sulphate as indicator[5]) subject to error, unless of course the solutions have previously been boiled to expel dissolved oxygen and the titration is carried out in an atmosphere of nitrogen or carbon dioxide.[6] Reasonably accurate and reliable results, it is stated, are obtained by the following procedure. In a porcelain dish are placed 20 c.c. of a standard solution of potassium ferricyanide, containing 80 grms. per litre, and a little ferrous sulphate, *i.e.*, sufficient to form a blue colloidal solution of Turnbull's blue, but not a precipitate. A slight excess of the powdered hydrosulphite (0·6 to 0·8 grm.) is weighed out in a scoop, and the salt carefully dusted into the mixture with gentle stirring until the end-point is indicated by the change of colour from blue to bright reddish-yellow.[1] On again weighing the scoop (upon which only a small amount, say 0·1 to 0·2 grm. should be left), the weight of the salt used is obtained, and the percentage result is calculated by noting that 174 parts of $Na_2S_2O_4$ are equal to 658·5 of K_3 Fe $(CN)_6$; or in other words that 20 c.c. of the ferricyanide solution correspond to 0·4228 grm. of $Na_2S_2O_4$. The accuracy of the method will depend on the skill of the operator in dusting the powder into the ferricyanide mixture ; but in the case of hydrosulphite this is said to offer no difficulty with a little care and practice. There is a small constant error due to the oxygen dissolved in the solution, but this is probably under 0·5 per cent. Some of the results obtained in the case of lots of hydrosulphite that had been kept for a time showed 55·1, 68·9, 70·8 and 78·4 per cent., pointing to the deterioration of the product storage. A freshly made sample gave 90·0 per cent.

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[1] *I.S.J.*, 1916, 466; also 1916, 139.

[2] *I.S.J.*, 1915, 236; 1919, 354.

[3] $Fe_2(SO_4)_3 + Cu_2O + H_2SO_4 = 2FeSO_4 + 2CuSO_4 + H_2O$.

[4] *Archief*, 1916, 24, 1972.

[5] *Rec. trav. chim. Pays-Bas*, 1894, 13, 36.

[6] *Zeitsch. ang. chem.*, 1905, 168.

PRODUCTION OF ALCOHOL FROM MOWRA (MOHRA) FLOWERS. *H. N. Morris. Chemical Trade Journal, 1920, 66, No. 1724, 737.*

Criticisms of the figures recently published by the Imperial Institute[2] are offered. In the first place, the cost of collecting and drying the flowers, instead of being about 30s., would be at least 60s. per ton. A yield of 90 gallons of 95 per cent. alcohol is excessive, and the actual figure from an existing factory over a long period is slightly under 60 gallons per ton of flowers. Thus the cost per gallon for materials only would be approximately 1s. As to the manufacturing cost, this would be about 12 annas per gallon of pure alcohol; and even if by large scale work and more scientific control this could be reduced somewhat, there is no hope for producing commercial alcohol at a price to compete with petrol as a motor spirit.

Moreover, the flower is used as a food by the people, and the market price before the war was Rs 42 per ton, and last year was Rs. 150 to Rs. 175 per ton. If the material is worth Rs. 175 per ton as a food, where is the economy of making alcohol from it, at a yield of 60 gallons a ton? The value of the alcohol exclusive of cost of manufacture would be Rs. 2·14 per gallon, or at an exchange rate of 2s. to the rupee, 5s. 9d. per gallon. Even taking the pre-war market price of the flower at Rs. 42 per ton, the value of raw material alone works out at 11 annas, or 1s. 4d., per gallon of alcohol. There are cheaper and more reliable sources of industrial alcohol than this.

COMPARATIVE COST OF PRODUCTION OF NITROGENOUS FERTILIZERS, ETC., BY SYNTHETIC AND NON-SYNTHETIC METHODS. *Anon. Chemical Trade Journal,* January 31st, *1920, 125-129.*

Evidence dealing with the economics of the established synthetic and non-synthetic processes for the production of nitrogenous compounds is summarized in the report of the Nitrogen Products Committee in the following salient points and conclusions: (1) The market price of a metric ton of combined nitrogen in the United Kingdom prior to the war was £66 or £67, that is, for ammonium sulphate or Chile nitrate; (2) synthetic processes can produce a metric ton of combined nitrogen at a cost of £20 to £30 ; (3) synthetic processes can produce a metric ton of concentrated nitric acid for about half the cost of the Chile nitrate retort process ; and (4) synthetic processes can produce a metric ton of combined nitrogen ready for the fertilizer market as cyanamide (nitrolim) or ammonium sulphate at a cost of about one half the *pre-war* market price of combined nitrogen in the United Kingdom.

J. P. O.

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[1] Reaction is : $Na_2S_2O_4 + 2\ K_3Fe(CN)_6 = 2\ SO_2 + 2\ K_3NaFe(CN)_6$.

[2] *I.S.J.*, 1920, 282-283.

Review of Recent Patents.[1]

UNITED STATES.

REVIVIFICATION OF VEGETABLE DECOLORIZING CARBON, USING SULPHITES. *George Blardone*, of New Orleans, La., U.S.A. *1,327,222.* Date of application, July 9th, 1917; patented, January 6th, 1920.

Spent decolorizing carbon is revivified by treating with a solution of a sulphite or sulphurous acid. In an experiment, 2 grms. of a carbon which had been employed for a considerable time in sugar refining, and had adsorbed pectins and gummy substances, was boiled for 30 minutes with 200 c.c. of a 10 per cent. solution of sodium bisulphite to effect revivification, and a 2 per cent. solution of sulphurous acid used in the cold also gave good results. Any suitable sulphite or bisulphite may be used, and the weight of the salt should at least equal that of the carbon. Heat may or may not be applied.

MANUFACTURE OF DEXTRIN, AND OTHER MODIFIED STARCH PRODUCTS. *H. C. Gore.* *1,335,162.* Date of filing, June 21st, 1919; patented, March 30th, 1920.

A process of making dextrin is described, consisting in adding to a quantity of starch a suitable amount of acidulated water together with a small proportion of dextrin to act as binder, this mixture being formed into an open mass, dried, and dextrinized with a current of warm air.

REMOVAL OF SCALE FROM EVAPORATORS, VACUUM PANS, AND JUICE HEATERS, USING A SOLUTION OF SULPHUROUS ACID. *Edward H. Man*, of New Orleans, U.S.A. *1,326,280.* Date of filing, November 23rd, 1917; patented, December 30th, 1919.

A solution of sulphurous acid is allowed to remain in the vessel overnight, when it will be found that the scale has become so softened that it may easily be removed by scraping or brushing, This reagent is stated to be more effective and more economical than caustic soda or hydrochloric (muriatic) acid. In a factory producing 500 tons of sugar in 24 hours, the sulphur dioxide necessary for making the solution may be obtained by the burning of only 8 lbs. of sulphur daily.

FILTER-PRESS WITH MEANS FOR DETERMINING THE THICKNESS OF THE CAKE. *Ernest J. Sweetland*, of Montclair, New Jersey, U.S.A. *1,313,929.* Date of application, February 2nd, 1917; patented, August 26th, 1919. (Five figures).

When using filters of the leaf type, as claimed in a previous specification,[2] it is extremely important to be able to determine the thickness of the cake under formation, so that the attendant may discontinue the supply leaving a suitable space between adjacent filter-leaves which is not so solidly filled with cake as to make it practically impossible to wash evenly and efficiently. A device has therefore been invented to indicate visibly or audibly when the thickness of the cake reaches a critical dimension. Claim is made for "the combination with a filter comprising a casing and a filter element mounted in said casing, of means for testing the thickness of filter cake forming upon said filter element, including a rod extending into the filter casing, a laterally projecting arm connected to said rod within the filter casing and adapted to engage the surface of the cake formed on the filter element, and also of means for longitudinally adjusting said rod and a scale carried by said rod exteriorly of the filter casing for indicating the distance of the said laterally projecting arm from the filter element."

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[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 2 fr. 00 each).

[2] United States Patent, 1,083,305; and United Kingdom Patent, 9019 of 1914, *I.S.J.*, 1916, 288.

EXTRACTION OF SUGAR FROM DESICCATED BEETS. *George H. Benjamin*, of New York, U.S.A. *1,319,320.* Date of filing, April 6th, 1915; patented, October 21st, 1919. (Three figures.)

In a previous patent,[1] the inventor has protected a process of desiccating beets for the production of a material that may be stored for a length of time. In the present specification a method is described for the extraction of the sugar from this dried product the various steps of which are as follows:—(1) Adding water at 158°F. (70°C.) to the dried cossettes to cause endosmosis of the water; (2) circulating the liquid to effect extraction of the sugar; (3) defecating with a substance as mono-calcium phosphate; (4) filtering to remove insoluble matters; and lastly (5) delivering to a tank from which the juice may be fed to the multiple effect evaporator. Apparatus is described for carrying out these several operations.

ROTARY DISC FILTER, MAKING PROVISION FOR DRYING THE CAKES. *Orange J. Salisbury*, of Salt Lake City, Utah, U.S.A. *1,336,444.* August 29th, 1917; April 13th, 1920. (Four figures.)

Heat is applied to the cake *in situ* and the heating elements may be electrically or steam-heated segments placed adjacent. Alternatively, heated air is passed through the cake while still on the filtering medium.

BEET PULLER. *Wilhelm Schmidt*, of Monroe, Washington *1,340,796.* April 15th, 1919; May 18th, 1920.

JUICE OR SYRUP FILTERING APPARATUS. *Aurelio Azpiazu*, of Habana, Cuba. *1,332,877.* October 14th, 1918; March 9th, 1920. (Seven figures.)

It comprises a series of conical filtering surfaces of wire screen arranged one above the other so that the juice or syrup falls from an upper service upon the next lower one, suitable channels being provided for discharging the filtered liquid from the apparatus. Means are also provided for easily cleansing the surfaces; while the apparatus is divided into sections which can conveniently be taken apart.

FILTER-PRESS FOR EXTRACTING BUTTER FROM COCOA LIQUOR. *Alonzo L. Bausman*, of Chicopee, Mass., U.S.A. (*National Equipment Co.*, of Springfield, Mass., U.S.A.). *1,331,453.* October 2nd, 1918; February 17th, 1920. (Five figures.)

DEVICE FOR STRIPPING CANE, ETC. *James W. Swayngim*, of East Laport, North Carolina, U.S.A. *1,311,191.* August 22nd, 1918; July 29th, 1919. (Four figures.)

An appliance is described by means of which the leaves may be stripped from cane or sorghum stalks by drawing them (by hand) through a hole, formed by slides controlled by springs.

CANE MILL. *Judson Buchanan*, of Chattanooga, Tennessee, U.S.A. *1,309,015.* October 31st, 1916; July 8th, 1919. (Seven figures.)

The invention relates to a vertical 3-roller mill (presumably cattle-driven), in which the contour of one of the rolls is modified so as to more effectively grasp and crush the stalks.

SCREEN FOR CENTRIFUGAL MACHINES. *Hans L. Jorgensen*, of Chicago (assignor to the *Harrington & King Perforating Co.*, of Chicago, U.S.A.) *1,333,719.* July 28th, 1919; March 16th, 1920. (Six figures.)

Claim is made for a screen or lining for centrifugals "comprising a perforated sheet bent with one end lapped over the other, one of said ends having circumferentially elongated apertures and the other end having lugs cut from the area of the sheet, extending through the respective apertures, the width of each lug being less than the length of its aperture to allow the circumferential play of the overlapped ends."

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[1] U S. Patent, 1,307,840; *I.S.J.*, 1918, 146.

CONDENSER SYSTEM AND VACUUM PUMP. *John F. Grace*, assignor to *Worthington Pump and Machinery Corporation*, of Virginia, U.S.A. *1,340,165*. May 26th, 1919; May 18th, 1920.

UNITED KINGDOM.

TUBULAR HEATING SYSTEM FOR VACUUM PANS. *Fawcett, Preston & Co., Ltd.*, of Liverpool (communicated by *Herbert W. Taylor*, of Phœnix, Mauritius). *140,635* (*11,042*). May 3rd, 1919; complete accepted, April 1st, 1920. (Two figures.)

It is the purpose of this invention to provide improvements in connexion with the tubular heating apparatus of vacuum pans, by which the construction is simplified and cheapened, and the efficiency so increased that a smaller quantity of surface is required for the necessary heating. Referring to the figures, the heating apparatus is seen to comprise a series of tubes *4* connected to two headers *5*, *5*^{1} in the bottom of the pan or vessel *1*, the steam being caused to circulate to and fro between the headers by the tubes both on the right and left hand sides by means of partition *7* arranged in the headers. The tubes *4* are preferably segmental in shape, the inner ones extending through a semicircle, and the outer ones through a quarter of a circle, being connected to the headers at one end and to an intermediate divided socket-fitting *9* at the outer end. The headers are formed in halves bolted together, and are supported in the pan at one point by the connexion between the inlet header *5* and the inside of the pan, and at other points by means of pivoted suspension links *10* which allow for expansion of the tubes. In the construction shown, the steam is admitted to the header *5* through an inlet *6* and passes by means of the four uppermost tubes on each side to the header *5*^{1}, thence by the next four lower tubes back to the inlet header, and so on, finally passing to the outlet *8*. Drainage apertures *12* are formed in the partition *7* so as to conduct condensed water to the outlet *8*.

FIG 1

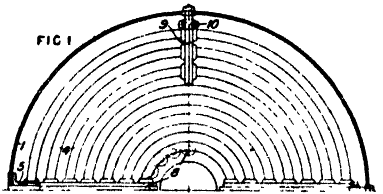
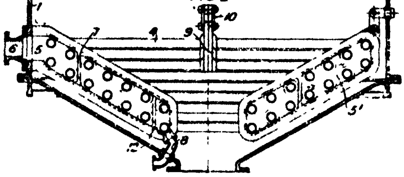


FIG 2



FILTERS AND FILTER-PRESSES. *Arthur R. Peck*, of Los Angeles, Cal., U.S A. (1) *138,657* (*17,256*). Date of application, October 22nd, 1918; complete accepted, February 19th, 1920. (2) *139,390* (*16,240*). Date of application, October 22nd, 1918; complete accepted, February 23rd, 1920.

MANUFACTURE OF DECOLORIZING CARBON FROM BITUMINOUS SHALES, ETC. *Broxburn Oil Co., Ltd., and Richard T. Findlater*, of Glasgow, Scotland. *133,452* (*16,542*). Date of application, October 11th, 1918; complete accepted, October 13th, 1919. (Two figures.)

The carbonaceous residue of the distillation of bituminous shales, cannel coal, etc., is ground, washed, and digested with sulphuric, hydrochloric, nitric, or hydrofluoric acid. It is washed in a filter-press; and the cakes obtained digested with caustic soda. This mixture is filtered in a press, and finally washed with water, dilute acid, and again with water. Alternatively, the material may be treated with acid as described, then with sodium carbonate, lastly with caustic soda.

EVAPORATION WITH THERMO-COMPRESSION. *Metallbank u. Metallurgische Ges.*, of Frankfurt, Germany. (1) *138,871 (3895).* Date of application, February 9th, 1920; *not yet accepted.* (2) *140,059 (3896).* Date of application, February 9th, 1920; *not yet accepted.*

(1) A single effect apparatus is described in which the vapours generated are compressed and used for heating the liquid in the evaporator.[1]

(2) In evaporating liquids by means of hot compressed vapour, either an extra supply of heat is added to the vapour by means of a steam jet, or the uncondensed vapour leaving the heating system is returned to the evaporator.

FILTER-PRESS WITH HYDRAULIC CLAMPING. *Soc. Anon. des Etablissements A. Olier*, of Puy-de-Dome, France. *138,317 (31,928).* Date of application, December 19th, 1919; complete accepted, March 31st, 1920. (Four figures.)

According to this invention, the plates of a filter-press are clamped and withdrawn by means of a double-acting hydraulic cylinder.

STARCH PREPARING MACHINERY. *American Laundry Machinery Co.*, of Cincinnati, Ohio, U.S.A. *135,588 (19,520).* Date of application, November 27th, 1918; complete accepted, November 27th, 1919. (Fifteen figures.)

BEET HARVESTING MACHINE. *Harry Kimble and Percival J. Beaumont*, of Watford, Herts. *139,723 (20,089).* Date of application, August 15th, 1919; complete accepted, March 11th, 1920. (Two figures.)

DRYING CONFECTIONERY. *J. W. Greer*, of Cambridge, Mass., U.S.A. *138,284 (21,660).* Date of application, September 3rd, 1919; complete accepted, February 5th, 1920.

A machine is described for supporting confectionery while drying. It comprises an endless conveyor travelling in a number of horizontal runs; a series of trays or carriers attached to the conveyor; and means for maintaining the trays in a horizontal position, both when travelling along a run and when being transferred from one run to another.

MANUFACTURE OF GLYCERIN FROM SUGAR PRODUCTS (MOLASSES, ETC.) *Vereinigte Chemische Werke Akt.-Ges.*, of Charlottenburg, Berlin, Germany.
(1) *138,328 (1974).* Date of application, January 21st, 1920; *not yet accepted;*
(2) *138,329 (1975).* Date of application, January 21st, 1920; *not yet accepted;*
(3) *138,330 (1976).* Date of application, January 21st, 1920; *not yet accepted;*
(4) *138,331 (1977).* Date of application, January 21st, 1920; *not yet accepted.*

(1) In obtaining glycerin by fermentation of sugars in presence of a substance of alkaline reaction as described in the parent specification,[2] the alkaline substance used is a sulphite, such as normal sodium sulphite, preferably with a hydrosulphite, or sulphoxylate, or other sulphur-acid salt that is a strong reducing agent. Materials producing a sulphite may be used. (2) In the manufacture of glycerin by fermentation of sugar in alkaline liquid as described in the parent specification and in the preceding specification, the yeast is purified and re-used, for example by washing in water, followed by growth in a dilute acid medium, and gradual neutralization with alkali. (3) In the manufacture of glycerin by fermenting sugar in alkaline liquid as described in the parent specification and in specification 138,328, the yield is increased by adding to the sodium sulphite or other alkaline salt a neutral salt of magnesium, aluminium, or an alkaline earth, or a neutral organic salt. Magnesium sulphate and chloride are particularly suitable. A 33 per cent. yield is given as an example. (4) In the manufacture of glycerin by fermenting sugar in a alkaline liquid as described in the parent specification and in specifications 138,328, 138,329, and 138,330, a further addition of sugar, with or without yeast

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[1] See also *I.S.J.*, 1920, 58, 117.

[2] United Kingdom Patent, 138,099; *I.S.J.*, 1920, 288.

and salts, is made when the fermentation has proceeded for some time, and preferably when it is at its highest point. Ammonium sulphate and potassium sulphate are given as examples of suitable salts in addition to those referred to in the said prior specifications.

FOOD PREPARATION CONTAINING STARCH. *W. Horlick*, of Racine, Wisconsin, U.S.A. *140,472* (*8310*). Date of application, March 20th, 1920 ; *not yet accepted.*

It is made by adding milk to a wort obtained from mixed mashes of potatoes and malt, and of wheat, oats, rye, corn, or other flour or corn starch and malt, and drying the product *in vacuo* at 120 to 125° F., or by spraying, or otherwise.

FILTER-PRESS PLATE. *Philip W. Norman and the Aluminium Plant and Vessel Co., Ltd.*, of London. *140,716* (*26,358*). Date of application, October 27th, 1919 ; complete accepted, April 1st, 1920. (Five figures.)

The filtered liquor is discharged from each plate of the filter-press to the common outlet passage through a straight drilled duct so inclined that it can be cleaned by the insertion of a brush.

COCOA MANUFACTURE. *L. Alberts*, of Zaandam, Holland. *140,703* (*22,429*). Date of application, September 12th, 1919 ; complete accepted, April 1st, 1920.

To cool cocoa which has been roasted and ground, in order to preserve its colour and prepare it for sifting, it is passed through a rapidly rotating sieve of coarser fabric than that to be subsequently used. A sieve of 25 meshes to the sq. cm. is mentioned.

MATERIAL FOR MAKING BISCUITS, CAKES, ETC. *F. J. Smith*, of March, Cambridgeshire. *139,611* (*5236*). Date of application, March 3rd, 1919 ; complete accepted, March 11th, 1920.

CONFECTIONERY MANUFACTURE. *P. Norwood*, of Ribbleside, Preston, Lancashire. *140,283* (*14,966*). Date of application, June 13th, 1919 ; complete accepted, March 25th, 1920.

A machine is described for coating nuts or other objects by conveying them through a molten bath of chocolate.

COCOA PREPARATION. *C. M. Wood*, of Upper Mountclair, New Jersey, U.S.A. *140,462 ; 140,463* (*8229 ; 8230*). Date of application, March 19th, 1920 ; *not yet accepted.*

It consists of cocoa and invert sugar syrup, to which flavouring matters, nut meats, etc., may be added.

MANUFACTURE OF FERTILIZER CONTAINING NITROGEN AND PHOSPHORIC ACID. *Norsk Hydro-Elektrisk Kvaelstofaktieselskab*, of Christiania, Norway. *132,496* (*18,536*). Date of application, July 25th, 1919 ; complete accepted, March 18th, 1920.

It has been observed that urea salts are capable (like acids) of reacting upon tricalcium phosphate, thus rendering the phosphoric acid soluble and available as a plant nutrient. A process is therefore claimed for the manufacture of a fertilizer consisting in mixing together in a dry condition 1000 parts of a natural phosphate (as Florida hard rock, Gafsa phosphate or apatite) and 1600 to 2400 parts of urea nitrate (produced by acting upon cyanamide with nitric acid). It is after this mixture has been distributed on the soil that the reaction takes place.

PREPARATION OF INULIN AND LEVULOSE FROM DAHLIA ROOTS, ETC *Arnold Daniel*, of Charlottenburg, Germany. *109,813* (*13,418*). Date of application, September 18th, 1917 ; complete accepted, March 4th, 1920.

In order to separate the non-inulin bodies (as albumenoids) from juices containing this carbohydrate, an excess of sodium carbonate or other alkaline substance is added and the temperature raised to about 80° C. for 30 to 90 minutes.

Water-tube Boilers. *Stirling Boiler Co., Ltd., and Henry J. S. Mackay*, of Westminster, London. *139,426 (22,188)*. Date of application, September 9th, 1919; complete accepted, March 4th, 1920.

In the most general types of water-tube boilers, the water has a tendency to "heap up" in the steam drum in front of the rear drum, causing priming. In order to overcome this disadvantage, it is usual to connect the water-space of the rear or feed-drum with the water-space of the steam drum in front of it by circulating tubes; but, while this arrangement prevents the heaping, it has the defect of allowing the hot water of the said drum to mix with the colder water of the rear drum, causing a reduction in the head of heat of the gases transversing the rear bank of tubes. A reduction in the efficiency of the boiler results. In accordance with this invention the admixture of hot and cold waters is avoided by providing in the rear or feed drum a partition so arranged as to separate the rear drum into two portions, one of which includes the ends of the tubes connecting the water spaces of the rear steam drum and the steam drum in front of it and the ends of some of the straight tubes of the rear bank. This partition may extend completely across the drum or may include only the straight tubes of the rear bank opposite the circulating tubes.

UNITED KINGDOM COMPLETE SPECIFICATIONS ACCEPTED.[1]

Centrifugal Machine Unloaders. *S. S. Hepworth Co. 143,900 (14,550)*. September 4th, 1914.

Belt Tighteners. *S. S. Hepworth Co. 143,901 (14,551)*. September 29th, 1916.

Centrifugal Linings, *S. S. Hepworth Co. 143,902 (14,552)*. July 19th, 1918.

Centrifugal Machines. *S. S. Hepworlh Co. 143,903 (14,553)*. October 30th, 1918.

Yeast Food. *W. A. and E. W. Geere. 143,938 (11,294)*. August 4th, 1917.

Liquid Fuel. *Industrial Alcohol Co. 144,052 (11,418)*. May 7th, 1919.

Alcohol Manfuacture. *A. B. C. Rogers and Sir C. H. Bedford. 144,079 (13,338)*. May 27th, 1919.

Yeast Production. *A. Meyer. 144,244 (28,594)*. May 31st, 1919.

Pressure Filters. *United Filters Corporation. 144,278 (14,800)*. May 18th, 1916.

Boilers. *W. Nakagawa. 144,741 (21,081)*. December 17th, 1918.

Machines for Harvesting and Windrowing Cane. *H. O. Scranton. 144,904 (18,113)*. July 21st, 1919.

Centrifugals. *G. H. Elmore. 144,979 (3644)*. February 6th, 1920.

Electric Heating Elements. *Akt.-Ges. Kummler & Matter. 145,076 (16,314)*. June 16th, 1919.

Evaporation or Inspissation of Solutions. *G. A. Krause. 145,076 (16,314)*. January 29th, 1917.

Suppressing Froth when Boiling Liquids. *E. Wirth-Frey and E. Jenny-Henz. 121,293 (20,169)*. December 5th, 1918.

Liquid Meters. *A. W. Empson. 144,346 (3087)*. February 7th, 1919.

Condensing Apparatus. *J. McOustra. 144,413 (7581)*. March 26th, 1919.

Filters. *E. S. Arrighi. 144,561 (30,675)*. December 8th, 1919.

Glycerin Production from Sugar. *Vereinigte Chemische Werke Akt.-Ges. 138,329 (1975)*. April 22nd, 1916. (Addition to 138,099).

Evaporation of Syrups. *A. Rambaud. 144,631 (15,019)*. June 10th, 1919.

Continuous and Systematic Lixiviation. *Soc. Gen. d'Evaporation Procédés Prache & Bouillon: 144,721 (18,868)*. April 7th, 1914.

Decolorizing Liquids. *Elektro-Osmose Akt.-Ges. 144,727 (15,882)*. February 12th, 1919.

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[1] The date given is that of application.

Sugar Crops of the World.

(Willett & Gray's Estimates of Crops to June 24th, 1920.)

	Harvesting Period.	1919-20. Tons.	1918-19. Tons.	1917-18. Tons.
United States—Louisiana	Oct.-Jan.	108,035	250,802	217,499
Porto Rico	Jan.-June	426,631	362,618	413,958
Hawaiian Islands	Nov.-July	507,000	538,913	515,035
West Indies—Virgin Islands	Jan.-June	12,000	9,000	5,400
Cuba	Dec.-June	3,650,000	3,971,776	3,446,083
British West Indies—Trinidad	Jan.-June	65,000	47,850	45,256
Barbados	,, ,,	50,000	80,000	65,230
Jamaica	,, ,,	50,000	40,000	34,300
Antigua	Feb.-July	15,000	12,841	9,409
St. Kitts	Feb.-Aug.	11,000	9,300	8,846
Other British West Indies	Jan.-June	10,000	10,000	16,745
French West Indies—Martinique	Jan.-July	22,000	10,027	20,881
Guadeloupe	,, ,,	31,000	26,604	30,382
San Domingo	Jan.-June	150,000	158,309	127,322
Haiti	Dec.-June	5,000	3,300	....
Mexico	,, ,,	85,000	60,000	40,000
Central America—Guatemala	Jan.-June	15,000	13,441	22,809
Other Central America	,, ,,	20,000	15,000	10,000
South America—				
Demerara	Oct.-Dec. and May-June	90,000	107,560	108,181
Surinam	Oct.-Jan.	12,000	8,000	9,739
Venezuela, *exports*	Oct.-Dec.	18,000	15,000	10,751
Ecuador	Oct.-Feb.	7,000	7,000	8,000
Peru	,, ,,	300,000	300,000	253,176
Argentina	May-Nov.	260,000	130,266	87,699
Brazil	Oct.-Feb.	187,000	183,079	148,958
Total in America		6,106,666	6,370,686	5,655,659
Asia—Brit. India (consumed locally)	Dec.-May	3,001,000	2,370,000	3,311,000
Java (1920-21, 1,460,000)	May-Nov.	1,335,763	1,749,408	1,778,345
Formosa and Japan	Nov.-June	300,000	415,678	397,618
Philippine Islands, *exports*	,, ,,	225,000	195,289	216,260
Total in Asia		4,861,763	4,730,375	5,703,223
Australia	June-Nov.	175,000	209,853	324,260
Fiji Islands	,, ,,	60.000	80,000	70,800
Total in Australia and Polynesia		235,000	289,853	395,060
Africa—Egypt (consumed locally)	Jan.-June	90,000	82,000	79,450
Mauritius (1920-21, 300,000)	Aug.-Jan.	235,490	252,770	226,000
Réunion	,, ,,	40,000	50,000	50,000
Natal	May-Oct.	150,000	185,000	106,250
Mozambique	,, ,,	50,000	50,000	50,000
Total in Africa		565,490	619,770	511,700
Europe—Spain	Dec.-June	3,000	6,618	7,039
Total cane sugar crops		11,771,919	12,017,302	12,272,681
Europe—Beet sugar crops		2,762,794	3,698,908	4,289,206
United States—Beet sugar crop	July-Jan.	652,957	674,892	682,867
Canada—Beet sugar crop	Oct.-Dec.	16,500	22,300	11,250
Grand total Cane and Beet Sugar	**Tons**	**15,204,170**	**16,413,402**	**17,256,004**
Estimated decrease in the world's production	**,,**	**1,209,232**	....	....

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

	One Month ending June 30th.		Six Months ending June 30th.	
Unrefined Sugars.	1919. Tons.	1920. Tons.	1919. Tons.	1920. Tons.
Russia	....	....	....	..
Germany	....	100	....	5,780
Netherlands	....	....	1	....
Belgium	....	....	....	....
France	....	....	....	....
Austria-Hungary	....	....	....	....
Java	25,809	11,647	112,862	11,809
Philippine Islands	....	....	....	....
Cuba	86,395	68,125	328,368	451,946
Dutch Guiana	73	....	1,034	31
Hayti and San Domingo	....	....	....	....
Mexico	....	....	....	....
Peru	5,054	1,857	27,428	22,319
Brazil	1,009	111	3,425	5,959
Mauritius	3,465	161	97,696	95,530
British India	....	5,676	....	12,751
Straits Settlements	....	....	....	....
British West Indies, British Guiana & British Honduras	23,020	30,291	62,410	85,542
Other Countries	6,393	1,156	9,087	15,500
Total Raw Sugars	**151,218**	**119,124**	**642,311**	**707,167**
Refined Sugars.				
Russia	....	....	....	....
Germany	....	....	....	126
Netherlands	2,133	16	2,133	1,071
Belgium	983	592	1,292	1,698
France	5	7	22	10
Austria-Hungary	....	7	....	123
Java	3,832	....	52,713	7,423
United States of America	29,172	6,849	123,929	81,419
Argentine Republic	....	7	8	19
Mauritius	1	....	12,657	....
Other Countries	14,645	219	25,807	7,382
Total Refined Sugars	**50,771**	**7,698**	**218,561**	**99,271**
Molasses	5,297	7,758	58,663	46,397
Total Imports	**207,286**	**134,580**	**919,535**	**852,835**

EXPORTS.

British Refined Sugars.	Tons.	Tons.	Tons.	Tons.
Denmark	....	....	....	....
Netherlands	....	....	....	1
Portugal, Azores, and Madeira	....	....	....	....
Italy	....	....	....	....
Canada	....	....	....	....
Other Countries	87	35	515	150
	87	35	515	151
Foreign & Colonial Sugars.				
Refined and Candy	1	5	187	767
Unrefined	1,385	2,338	7,084	3,579
Various Mixed in Bond	....	....	....	....
Molasses	1,132	555	1,267	1,858
Total Exports	**2,605**	**2,933**	**9,053**	**6,855**

Weights calculated to the nearest ton.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1920. Tons.	1919 Tons.
Total Receipts January 1st to June 24th	1,649,182	1,564,293
Deliveries ,, ,,	1,649,182	1,560,293
Meltings by Refiners ,, ,,	1,462,119	1,471,000
Exports of Refined ,, ,,	270,000	215,000
Importers' Stocks, June 23rd	—	4,000
Total Stocks, June 23rd	52,614	104,783
	1919.	1918.
Total Consumption for twelve months	4,067,671	3,495,606

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1917-1918, 1918-1919, AND 1919-1920.

(Tons of 2,240 lbs.)	1917-18 Tons.	1918-19. Tons.	1919-20 Tons.
Exports	1,570,806	1,800,023	2,318,95
Stocks	1,088,259	1,192,732	661,76
	2,659,065	2,992,755	2,980,71
Local Consumption	51,400	47,000	39,70
Receipts at Ports to May 31st	2,710,465	3,039,755	3,020,41

Havana, May 31st, 1920 J. GUMA.—L. MEJER.

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR SIX MONTHS ENDING JUNE 30th, 1913, 1919, 1920.

	IMPORTS.			EXPORTS (Foreign).		
	1913. Tons.	1919. Tons	1920. Tons.	1913. Tons	1919. Tons.	1920 Tons
Refined	429,217	218,561	99,271	533	187	76
Raw	546,678	642,311	707,167	2,104	7,084	3,57
Molasses	75,508	58,663	46,397	181	1,267	1,85
	1,051,403	919,535	852,835	2,818	8,538	6,20

HOME CONSUMPTION.	1913. Tons.	1919. Tons.	1920. Tons
Refined	419,641	183,495	111,90
Refined (in Bond) in the United Kingdom	355,358	404,185	385,76
Raw	60,616	172,579	131,44
Molasses	15,660	26,357	19,08
Molasses, manufactured (in Bond) in United Kingdom	19,299	35,905	41,91
Total	870,574	822,521	690,10
Less Exports of British Refined	12,837	515	151
	857,737	822,006	689,95

Sugar Market Report.

Our last Report was dated 6th June, 1920.

There is no change to report in the official prices as fixed by the Royal Commission last month.

Following the issue of a Government order regarding West India Crystallized and Grocery Syrups (hitherto deliverable only against domestic and manufacturing vouchers) permitting their sale as "free" sugars, a steep decline of some 14s. per cwt. immediately occurred for Crystallized descriptions, viz., from 154s to about 140s. Syrups and Muscovados have become increasingly difficult of sale, owing to the competition of British Refiners' Pieces, values being very irregular and almost nominal.

The f.o.b. quotation for 96 per cent Cubans stands to-day at about 17 cents as against 19½ cents at the date of our last Report. The confidence displayed some weeks ago has given place to feelings of nervousness in regard to the maintenance of prices, even at the reduced level now reached. This change of sentiment may be attributed to the growing belief that America may prove to have been somewhat hasty in providing for an increased consumption (which so far shows no signs of eventuating), coupled with the expectation that Cuba may, after all, produce 150,000 to 200,000 tons more than recent lowest estimates.

Statistical tableaux, compiled by reliable statisticians, show an available supply for the United States during the year 1920 of about 4,750,000 tons. This calculation is based on a Cuban crop of 3,700,000 tons, but in view of recent advices from the island, the above total may be reasonably increased to 4,900,000 tons. In the late Autumn of last year a consumption of 5,000,000 tons for 1920 was freely predicted in American sugar circles, but these forecasts were made at a time when the Cuban quotation stood in the neighbourhood of 8 cents as against 17 cents to-day. Such estimates appear now extravagant and impossible of attainment; in some quarters it is doubted whether as much as 4,500,000 tons will be absorbed. Messrs. WILLETT & GRAY's figures of consumption for the first half of this year are not yet to hand, but private calculations made up to the end of May indicate a reduction of 90,000 tons as against the corresponding period of last year. Compared with Messrs. WILLETT & GRAY's consumption figure for 1919, viz., 4,067,000 tons, an increase to 4,500,000 tons would appear a considerable accomplishment. Assuming, however, the correctness of the calculation of 1919 consumption made by the American Sugar Refining Company, viz., 4,332,000 tons (this figure includes certain internal deliveries apparently not reckoned by Messrs. WILLETT & GRAY) an advance to 4,500,000 tons would indicate little more than the normal rate of increase. Bearing in mind that the large quantity of sugar represented by American Home and Colonial production must necessarily find its market in the United States, and that about 550,000 tons of extraneous sugars, mainly for Autumn delivery, have been actually contracted for shipment thither, it would appear that a disappointment in consumption would be to the detriment of Cuban imports, and it seems not improbable that Cuba may have to carry over a quite important stock at the end of the campaign.

In Java a heavy decline followed the cessation of American enquiries, the quotation for early Autumn deliveries falling from 70 guilders to 58 guilders. This movement was succeeded by a recovery to 65 guilders, and to-day Whites for July-August shipment value 62 guilders, say about 98s. per cwt. f.o.b. As regards the next crop, the price of 50 guilders was fixed by the Combine for Whites and 48 guilders for Browns, June shipment, at which some business was effected. The Combine are not quoting for July 1921, but speculative offers of Whites are in the market at 48½ guilders per picul, equal to about 77s. per cwt. f.o.b. So long as the American enquiry dominated the market, European buyers were unable to keep pace with the movement, but some revival of Continental demand has been noticeable of late, and sales of Whites to Mediterranean and Northern ports have been reported at about 106s. per cwt. c.i.f.

H. H. HANCOCK & Co.

10 & 11, Mincing Lane,
London, E.C. 3,
8th July, 1920.

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

Notes and Comments.

Sugar Prices in Great Britain.

A good deal of fuss has been made in the British press the last two months over the claims of a Mr. Cairns, a gentleman hailing from Inverness, that the Royal Commission for the Sugar Supply was charging excessive prices for its sugar and that he if he were allowed to import it could bring into this country 3000 tons of sugar a fortnight and sell it at 8d. or 9d. a lb., as compared with the price of 1s. 2d., authorized by the Royal Commission. As at the time Mr. Cairns made this claim the Select Committee on National Expenditure was sitting investigating analogous matters, they thought it of sufficient importance to warrant investigation, inasmuch as Mr. Cairns' claim impugned the ability of the Royal Commission and its expert buyers to secure our sugar as cheaply as possible. Mr. Cairns was therefore summoned to attend at the House of Commons and justify his claim. He was given a careful hearing; he advocated the free importation of sugar instead of the present system and claimed to be able to import 90,000 tons of sugar a year and sell it to the wholesale dealers at 8d. per lb.

The Select Committee have now issued a periodical report, in which they mention the result of their investigations with Mr. Cairns. The Government policy, they state, is to maintain control so long as there is world shortage of supply and the present exceptional instability of markets. "The Sub-Committee does not dispute the possibility of private traders being able to import sugar, but, after weighing the evidence, they doubt whether it would at present be possible to put any quantity on the market at a wholesale price of 8d. a pound unless much of the sugar were to be of a quality inferior to that now supplied by the Sugar Commission. Mr. Cairns himself admitted that the sugar at his disposal ran from 75 to 95 per cent. polarization, although the polarization of white table sugar as at present supplied by the Sugar Commission is 99½ per cent. It is important that it should be widely known that no licence is required at present in order to import, for manufacturing purposes, any sugar of a polarization not exceeding 91 per cent. The 90,000 tons offered by Mr. Cairns represents only about one thirteenth of the present annual consumption of sugar in this country, and it would only be imported fortnightly in small quantities. It is obvious, therefore, that such a quantity, even if it were of the present standard quality, would not materially affect the wholesale price."

This is only what might be expected. It is ridiculous to suppose that the expert brokers who buy for the Royal Commission and who have all the facilities they need for investigating the world market are unable to secure the nation its sugar supplies save at an excessive price; or that they can be totally ignorant of any supplies of such magnitude as to materially affect the ruling price if imported at a lower figure. If anything is clear, it is that our sugar imports, obtained under the ægis of the Royal Commission and its expert advisers, are in the present condition of the world's sugar supply better assured of successful purchase at a fair price than would any amount of private transactions, such as in normal times would be a regular business. In these abnormal days of sugar shortage the risks attending private enterprise are too great to be permitted, all the more as it is evident that some of the would-be dealers in sugar are not sufficiently acquainted with the technique of the business and are keener on speculation than on the legitimate supply of the United Kingdom sugar consumption. For a good while yet, it is consequently necessary for the Royal Commission to retain the reins and continue to control the purchase of the sugar needed in this country.

It is a pity that so much has been made of this matter in the daily press, since there has been in consequence far too general a tendency on the part of the public to impugn the work of the Royal Commission, on the strength of Mr. Cairns' allegations. It is to be hoped that the result of these investigations on the part of the Select Committee will be to reconcile the public to the knowledge that the Royal Commission are doing the best they can for them within reasonable limits, and that it is not their fault that the retail price of sugar is so high.

It may be added that the report of the Special Committee also contains the announcement that British refiners have now obtained additional machinery, and their average weekly output of refined shows a substantial advance on the output of 1918. This will decrease the necessity of having recourse to American refined, which, in view of the increased excess of the cost of refining sugar in the United States compared with this country, will be all to the good from the British point of view.

The United States Consumption.

Messrs. Willett & Gray have just published the figures of consumption of sugar in the United States for the six months ending June 30th last; these show a total of 2,207,428 tons in refined value as compared with 2,120,609 tons for the same period in 1919. The six months' consumption this year shows an increase of only 86,819 tons, or 4·09 per cent. over the figure of 1919.

A part of the trade, says our contemporary, has been calculating on an immense increase in the consumption this year on account of "prohibition," but although there has been an increase, its extent has been curtailed to a large degree by high prices and the inability at times of sugar buyers to secure delivery, owing to railway congestion and strikes. As to the relation of the first six months of 1920 to the last six months (July–December) Messrs. Willett & Gray point out that "when consumption figures are compiled for the calendar year, it is possible in January to arrive at a very accurate result because in most instances that is just at the beginning of the new crop season and old crops have been exhausted and stocks in all hands from producer to ultimate consumer have run down to a very low point in anticipation of new crop sugars (with usual accompanying declining prices). However, in July the reverse is usually the case; sometimes stocks are large not only in producers' hands but in jobbers', manufacturers' and even in the household—buyers anticipating their spring and summer demand, part of which is to be consumed after July 1st, but which necessarily must be included as a refiners' delivery during the first six months and hence considered consumed during that period. For this reason, consumption of sugar during the first half of the year, usually is in excess of that of the second half. Therefore, it is not exactly correct to take the consumption of the first half year and double it with the expectation of having an approximate figure of the consumption for the entire calendar year."

From this argument of Messrs. WILLETT & GRAY it would seem logical to assume that the American consumption for the whole of 1920 is not likely to be much over 4,000,000 tons, instead of the 4,700,000 tons which a few months ago seemed a feasible achievement. If so, then the probability of a surplus existing at the start of the new Cuban crop is strongly increased, and so are the chances of a fall before long in the present abnormal prices. But other views incline to a higher figure and 4,500,000 tons is not an impossible maximum. What seems to be everywhere agreed is that 4,700,000 tons is no longer attainable.

Industry in India: a Commission Report on Sugar.

We learn that, after a strenuous period of touring throughout the sugar Provinces and a subsequent visit to Java, the Indian Sugar Committee has settled down in the cool heights of Simla to write their report. This is a wise move, as all who know what India is like at this time of year will agree. Meantime it may be of interest to recall the findings of Sir THOMAS HOLLAND'S Indian Industries Commission of 1916-18 on the sugar industry. The paragraph in the report on the sugar cane runs as follows:—"Turning to the sugar cane, although India possesses a larger acreage under this crop than any other country in the world, her imports of sugar have grown in recent years with very great rapidity, and, before the war, were exceeded only by those of cotton manufactures. The obstacles in the way of increasing local production lie mainly in the poor type of cane and the inferior cultural methods in the principal cane areas, the United Provinces, Bihar, Bengal and the Punjab, and in the very small holdings on which the cane is grown, with the consequent impossibility of securing the regular supply requisite for a modern central factory."

In a later chapter attention is drawn to the losses incurred in manufacture:—"Roughly, of the sugar consumed in India, three fourths are grown in the country and one fourth is imported. Roughly, also, of that grown in the country one third is wasted owing to the inefficiency of the primitive methods of extraction. Nearly one half of this loss might easily be avoided, and, if it were, the profits of cane cultivation would be greatly increased." It is noted that under favourable conditions sugar cane cultivation is exceedingly profitable, "but the average outturn throughout the country is exceedingly poor." . . . . "The ryot's difficulties are want of water for irrigation, the strain imposed upon his cattle during the cane-crushing season, and lack of capital." It is estimated that improvements in methods of extracting the juice may increase the yield by 10 per cent. and better cultivation would add another 20 per cent. This if effected would render the country self-supporting. The adoption of power crushing plants would cost roughly £30,000,000 and it is considered that this expenditure would be justified. Another £50,000,000, the report considers, might be profitably expended on improving the irrigation and cultivation. These are the basal facts brought out by the Industries Commission, but the way in which these improvements are to be brought about is not made clear. For this we shall have to wait for the findings of the Committee now at work.

South African Sugar Affairs.

As is known, the sugar production of South Africa has for the last few years been sold at prices considerably below the world's parity for sugars, the retail price in the Union having been in fact the lowest for the time being anywhere in the world. This has naturally caused considerable discontent amongst the sugar producers, who saw their contemporaries in other countries amassing big profits while they were tied down to returns which were in their opinion totally inadequate to cover the risks of the industry. Protracted discussions and negotiations have been proceeding for some time between the representatives of the Natal sugar industry and the South African Government, and as a result a new agreement was come to in June for the pricing and control of the sales of sugar within the Union.

For the purposes of the new regulations sugars are to be classified under three grades: No. 1 Grade, which shall comprise first quality white and first quality yellow sugars only; the producer's price is not to exceed 41s. per 100 lbs.; the wholesale price, 43s. 6d. per 100 lbs.; and the retail price 6½d. per lb. No. 2 Grade is to comprise second quality white sugar, and second quality yellow sugars only; the prices are respectively not to exceed 37s., 39s. 6d., and 6d. No. 3 Grade comprises all other sugars, and the maximum prices are respectively as above, 33s., 35s. 6d., and 5½d. In addition, the price of imported sugar, either wholesale or retail, is not to exceed 4½d. por lb. unless it is submitted for classification to the Board of Graders, in which event it may be sold for the price fixed for like grades of sugar.

This new price scale is certainly an improvement on the old one, which allowed the producer only £29 5s. per ton, but it is still below the world's price by a very considerable figure, and the Natal sugar producers are naturally not satisfied. Moreover, they have just discovered (as the *South African Sugar Journal* points out) that while in the past the planters have always been paid for their cane by weight, irrespective of what it produces, the new agreement appears open to the construction that they are now to be paid according to the proceeds realised on account of the increase in price, or on the average of sugars for the whole season, a fresh complication being thus introduced which will give rise to further dispute. The planters' representatives on the deputation allege that when they signed the agreement, they were under the impression that it stipulated for a fixed payment for the cane. The matter may not be of very great moment, but it is causing a good deal of irritation, and it will only add to the determination of the producers to fight for better terms at the earliest moment possible.

This moment may be expedited by the fact that the sugar industry in Natal has been visited just lately by an appalling drought, which is said to be the worst experienced for at least 35 years, and has led to the cane dying off at an unprecedented rate. This latter contretemps is due to abnormal alternations of heat and cold during the growing season culminating in this prolonged drought. Expert opinion inclines to the view that the growers have lost at least half their crops, and as the drought had not broken by the middle of June the worst was not then known. The result will be, in any event, a greatly restricted output of sugar. In past seasons, the planters have looked to their exports at a higher price to recoup them for the moderate returns from the inland sales, but in the coming crop there will be no surplus to export, so discontent with the regulated prices will be bound to augment. Last year, 188,000 tons of sugar were manufactured, of which 16,000 were exported, thus showing an apparent consumption in the Union of 172,000 tons. But it is averred by our contemporary that a large proportion of the sugar ostensibly consumed in South Africa was actually exported to other countries in the form of jams and preserved fruits. Purchased at £20 per ton, this sugar was sold at perhaps double if not treble the price when exported in a preserved form. Now that it is assumed by the producers that the supply of sugar from Natal will not suffice for the requirements of the Union, it may be requisite for the Government to take steps to ration the available quantity, or the only result will be the necessity of importing foreign sugar which would have to be bought at £100 per ton. Prices, consequently, are bound to go up still further as some check on consumption. Perhaps it would not be a bad thing for South African sugar producers if the consumer had to endure a spell of £100 sugar, since it might lead to a more reasonable price for the indigenous producers. These, we gather, consider that they are entitled to sell their products for at least 75 per cent. of the current world's price, and they cannot be blamed for asking for only that fraction.

The Anglo-Ceylon and General Estates.

As an instance of a successful business venture at present day prices, the annual report of the Anglo-Ceylon and General Estates, Ltd., makes interesting reading. It is true that this firm do not confine their sphere of activity to sugar, as they have rubber and other interests in Ceylon; but their Mauritius sugar estates are well known, and appear to provide the larger part of the firm's profits. For the year ending last March the Mauritius profits amounted to £107,000 as compared with £48,000 in the previous year. In spite of an increased expenditure in Mauritius and Ceylon of £189,000, the total profits of the company for the year amounted to £194,908, which when added to the balance carried forward from the previous year, showed a total disposable sum of £254,511. Of this £25,000 went in an interim dividend of 5 per cent., and another 20 per cent. is now declared, or 25 per cent. dividend for the year. A sum of £25,000 is placed to the reserve and the balance of £105,511 is carried forward, £40,000 of which is expected to go in Excess Profits Duty.

The chairman (Sir EDWARD ROSLING) in presenting his report to the general meeting remarked that while before the war their sugar was sold at about £10 per ton f.o.b., to-day it was worth nine times that figure. Of course like everything else the cost of production had increased enormously; planters' cane used to fetch 10s. 6d. per ton, but this year will probably cost between £6 and £7, and in addition to the increase in the cost of labour and food there is a 50 per cent. rise in the rate of exchange. In spite, however, of these increased costs, the prospects for the future are distinctly bright; and the directors have during the past season refused offers made from more than one quarter to purchase their Mauritius sugar interests.

The Present Position of Power Alcohol.

In view of the importance of investigating the possibilities of alcohol as a fuel, a Government Committee was appointed in October, 1918, to consider and report on the question. A year ago it issued its Report in the course of which it recommended that an organization should be established by the Government to initiate and supervise experimental and practical development work at home and overseas on the production and utilization of power alcohol. This recommendation resulted in the establishment of a small permanent organization under the Fuel Research Board, which latter body proceeded (last December) to appoint a Power Alcohol Investigation Officer in the person of Sir FREDERIC NATHAN. He has now published a summary of the present position of power alcohol. Primarily, be it observed, his standpoint is that of production within the British Empire.

The main sources of alcohol in this country (he observed) are either vegetable materials containing starch or sugar, or synthetic processes. But it may be stated that the production of alcohol in any considerable quantities from vegetable materials grown in the United Kingdom is not economically possible owing to the lack of acreage, the high cost of cultivation and harvesting, and the fact that the most suitable raw materials are also important foodstuffs. Alcohol can also be produced from the fermentable sugars formed by the hydrolysis of wood cellulose, and synthetically from calcium carbide or from the ethylene contained in coke oven and coal gas. But none of these processes is commercially feasible in this country owing to lack of sufficient raw material or to cost of production.

Molasses as a Source of Alcohol.

Considering next production in the Empire, Sir F. NATHAN acknowledges molasses as the raw material which can be converted into alcohol most cheaply. But he points out that the whole supply of alcohol from the resulting molasses from the Empire production of sugar would be no more, at the present day, than 17 to 18 million gallons of 95 per cent. alcohol, whereas the amount of petrol or gasolene required during 1920 in this country for internal combustion engines is estimated at 250,000,000 gallons. At present home distilleries can turn out as much as seven or eight million gallons of molasses alcohol, but in view of the present cost of materials and labour and of freight it would hardly be a commercial proposition to erect additional distilleries here for that purpose; it would be better to convert the molasses into alcohol where it is produced, to use the alcohol where it is made to supplement or replace petrol, and to export the balance. "With the present increasing output of cane sugar, there should be very considerable quantities of molasses available for the manufacture of power alcohol, and the possibility of using these molasses is being brought to the notice of the authorities of the countries concerned. Even in these favourable circumstances however, the quantities of power alcohol available from this source must be . . . . comparatively small, and will in the first instances mainly be used in replacement of petrol in the neighbourhood of its production."

Sir F. NATHAN touches also on the feasibility of using tropical vegetation other than sugar plants as a source of alcohol; but till a cheap and simple process, either chemical or bacteriological, is available and could be applied commercially on a large scale, which is not at present the case, this source while offering boundless possibilities is not practicable.

The conclusion Sir F. NATHAN comes to is that, as at present situated, our Imperial sources of alcohol are not of sufficiently great extent to have any marked effect on existing uses of fuel, and may not ever be available in sufficiently cheap supply to be a serious competitor with them in the United Kingdom. He therefore concludes that as in this country the natural source of heat and power is coal, it is to improved methods of utilizing the heat energies of coal that we must look for a cheap supply of power. "It is obviously the duty of our engineers to think in terms of coal and its fuel possibilities." As the principal products of coal are gas and coke, these forms of fuel ought to be used to the fullest extent.

New Legislative Facilities for Alcohol.

Fortunately while the Government expert does not hold out much prospect of any large substitution of alcohol for existing means of power in this country, the Government are not unwilling to facilitate its production and utilization so far as is feasible. A section of this year's Finance Bill provides for the use of a new description of methylated spirits to be called "power methylated spirits" for generating mechanical power, and for the payment of the same allowance in respect of such methylated spirits as applies to methylated spirits used for industrial purposes—namely, 3d. a proof gallon. It also gives powers to the Board of Customs and Excise to make regulations as to the composition and quantity of the denaturant. A denaturant will shortly be authorized for power methylated spirits which, it is hoped, will reduce to the minimum the cost of denaturating spirits to be used for this purpose. Clauses are also being inserted into the Revenue Bill extending facilities for the importation and distribution of spirits in bulk, and enabling the Board of Customs and Excise to make regulations providing for the use of alcohol in generating mechanical power. By this means it is officially hoped that the production and use of alcohol for power purposes will be much facilitated and that the expense connected with any necessary restrictions will largely disappear.

Future Possibilities.

While it may be the case that the amount of power alcohol available from British molasses sources is not great enough to have any marked effect on the use of petroleum spirit in the United Kingdom, it must not be overlooked that the quantity is little more than 5 per cent. of the total world's supply in normal times; and were it possible to utilize the large quantities of molasses at present run to waste in Java and Cuba, there would be available a tonnage of alcohol which would certainly not be inappreciable. Indeed, the alcohol producible from the world's supply of molasses would more than suffice for the present petrol requirements of the United Kingdom. It seems therefore incontestable that everything ought to be done to encourage the production commercially of molasses alcohol, and the legislative changes mentioned above may do something to assist matters, though it remains to be seen whether the inability to make the product duty free will not act as a serious bar to the industry. But once it is rendered possible for a demand to arise, that is, once a market is created and fiscally opened, the alcohol may be produced in the world in greater quantity than at present seems likely to the authorities. Sooner or later the vast resources of tropical vegetation will be conscripted to producing this form of power; and even if sugar-producing plants remain the chief raw material, it is not impossible that when the production of sugar in the world overtakes the consumption, as it will some day, surplus areas of cane will be grown solely for conversion into alcohol. Meantime, the production and use of alcohol in the localities where it is made from molasses should certainly be developed, since it would prove the cheapest method of experimenting into all the pros and cons of this alternative to existing power fuels.

The Cantley beet factory, which has been taken over by Messrs. Graham, Son & Hay, of Liverpool, is assured of a "campaign" this Autumn, as sufficient sowings of beet have been secured.

The Price of Sugar in the United Kingdom.

No Early Reduction Feasible.

The Ministry of Food issued the following communication to the Press on July 31st:—

In view of certain statements which have recently appeared in portions of the Press, the Royal Commission on the Sugar Supply thinks it desirable that attention should be called to the Notice issued by it for publication on February 6th, 1919, in the course of which it was intimated that adequate notice would be given to the Trade when the state of the world's sugar markets should be such as to allow a reduction to be made in the price of sugar in this country.

The recent statements referred to tend to suggest that the present retail price of 1s. 2d. per lb. for Grocery sugar is unwarranted by the prices ruling in the markets of the countries which produce sugar. Such a suggestion is totally unfounded. As a matter of fact, there is no country in the world in which sugar could be purchased at a price which would enable the buyer to bring it to this country and sell it, duty paid, at 1s. 2d. per lb. without incurring a substantial loss; and as the suggestion is calculated to give rise to the impression that an early reduction in current prices may be looked for, the Commission considers it right, with reference to its undertaking of February, 1919, to state that this is not the case.

It will not be possible to reduce the present price of 1s. 2d. perl b. until the prices in the world's markets fall to an equivalent level. So soon as this takes place the retail price in the United Kingdom will be reduced accordingly, and traders and retailers should, as formerly, watch for themselves the developments that take place abroad in order that they may keep themselves informed as to the probabilities, as no further notice of prospective changes in price will be made.

The *American Sugar Bulletin* prints some striking comparisons of Java and Cuba. Java is the second largest sugar exporting country in the world, surpassed only by Cuba; she produces one-half as much sugar as Cuba; has a population 13 times that of Cuba, a total area one-tenth more and a sugar area one-quarter that of Cuba. Her yield of cane per acre is twice that of Cuba, while the percentage of sugar extraction is one-tenth more. Java and Cuba have about the same number of centrales or raw sugar mills, but the former's average production per central is only one-half that of Cuba. The two together produce nearly one-third of all the sugar in the world.[1]

The use of arsenic for controlling grubs in the field has been tried by Dr. ILLINGWORTH, in Queensland. He used the poison in an insoluble form (as contrasted with the soluble form used in weedkillers where it is combined with an alkali), and distributed it at the rate of about 80 lbs. per acre. In order to get right amongst the grubs, he lifted out bodily a number of ratoon stools and mixed the poison with the soil before resetting them. The results were noted by digging out a few of the stools from time to time and observing the number of dead grubs. Within four days, 14 per cent. were dead; in seven days, 24 per cent.; in ten days, 34 per cent.; and in 20 days, 70 per cent. These results, according to Dr. ILLINGWORTH, would appear to be very satisfactory from the standpoint of killing the grubs, but of course the method of application is not to be recommended. However, if the poison were placed in the drill with the plants, it would be in a position among the roots whenever the young grubs became active. Dr. ILLINGWORTH finds it necessary to combat the ill-informed criticism that this use of arsenic would poison the cane juice. Using the arsenic in the insoluble form, it has no apparent action upon the cane plant, and probably lies inert in the soil until eaten by the grubs, when it is acted upon by their digestive juices, rendering it soluble and effective.

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[1] See also *I.S.J.*, 1919, 140.

The Rise in the Retail Price of Sugar in Europe.

The retail price of refined sugar in the different European countries has undergone considerable change the last few years. In the early years of the war, the economic consequences of the struggle did not make themselves felt keenly, but the prolonged work of destruction and of preparation for destruction influenced in the later years the food supply in such a manner that the commodities of life rose in price with astonishing rapidity in some countries, while they were maintained at almost the same level in others. We have compiled a list of prices of refined sugar in the different European countries and at a few typical periods, which prices are quoted in the monetary value and the weight of each country separately, and are therefore not mutually comparable. They are for refined, crystallized sugar, bought retail to the amount allowed by the ration in the given countries where sugar is still rationed. The fancy prices paid in some places for sugar over and above the ration are naturally not taken into consideration; what is implied here is the price paid by the ordinary citizen for that portion of sugar supplied to him under the laws of his country:—

COUNTRY.	PRICE OF SUGAR	January, 1918.	July, 1918	January, 1920.	July, 1920.	Increase in per cent. since Jan. 1918.
Germany	Marks per pound	0·80	0·80	2·10	2·10	162
Austria	Crowns per kilo	1·40	1·50	15.3	35·0	2400
Hungary	,, ,,	1·40	2·25	35·0	27·0	1830
Czecho-Slovakia	,, ,,	1·40	1·50	2·90	3·19	128
Netherlands	Guilders per kilo	0·55	0·55	0·60	0·60	9
Belgium	Francs per kilo	0·90	2·90	1·80	2·0	122
France	,, ,,	1·50	1·80	2·10	3·15	110
Italy	Liros per kilo	2·40	2·40	6·0	8·50	254
Spain	Pesetas per kilo	1·60	1·52	1·50	2·65	66

The French Minister of Finance has announced the prices to be paid, during 1920-21, for alcohol distilled from sugar beets. If sugar does not exceed 250 frs. per 100 kg. rectified pure alcohol will be 286 frs. per hectolitre (26·42 gallons); but if it exceeds 250 frs. the price of alcohol will advance from 0·682 fr. to 1·07 fr. for each franc advance in sugar. In addition, all agriculturists will receive a premium of 4 frs. per hectolitre for alcohol, distilled on the farm.

Tractors are becoming popular among cane planters in Formosa. At the Ujurin farm of the Toyo Seito Mill, it was reported possible by the use of these machines to till 9·6 acres in a day of 10 hours, although the soil operated was very sticky. The depth was 9½ in.; whereas not more than 5 in. can be reached with the ox-drawn ploughs at present in use, and the cost was reduced to half the existing rate. It is thought that tractors may make it possible to reclaim extensive cane lands in Southern Formosa, neglected so far on account of the very tenacious nature of their soil.

A new periodical, entitled *Journal de la Station Agronomique de la Guadeloupe*, edited by Mr. J. SYDNEY DASH, Director of the Station, has come to hand. This first number, although of modest size, promises well. It contains several articles of interest to planters, such as "Fertilizers and their Use"; "Cane Stripping"; "Mosaic Disease of the Cane," and "New Seedlings of the Guadeloupe Station." There are also a few abstracts from papers appearing in other publications, and altogether this new issue (which is printed in French) is excellent. In the last mentioned article, it is stated that about 2000 seedlings were obtained at the station last year, some of which have given satisfactory results. One of them was found to give a yield of cane of 227,219 kg. per hectare (about 90 tons per acre).

Fifty Years Ago.

From the "Sugar Cane," August, 1870.

EDWARD BEANES (whose name, it will be remembered, was associated with a process of eliminating the calcium carbonate from char by means of hydrochloric acid gas[1]) wrote in this issue an article descriptive of the processes of sugar manufacture in vogue in Cuba at that time. It appears that the copper-wall was still employed; and that clayed sugars of various grades were largely made, the time taken for curing these in the moulds being about 21 days, after which the loaves were dried in the sun. In a few factories, however, steam defecators, animal charcoal filters, multiple effect evaporators, vacuum pans, and centrifugals were introduced; while it is recorded that some white sugar was being made by washing in the machines with water or light liquor. The char, it is pointed out, served simply as a mechanical filtering medium, having generally long since lost its decolorizing power. No attempt seems to have been made to revivify it.

An abstract was given of the paper in which KNAPP[2] proposed to use an alkaline solution of mercuric cyanide for the determination of reducing sugars, the procedure recommended being as follows: 10 grms. of pure mercuric cyanide are dissolved in water, 100 c.c. of sodium hydroxide solution (1·145 sp. gr.) added, and the liquid made up to 1000 c.c. The sugar solution (containing not more than 0·5 grm. of reducing sugars per 100 c.c.) is run into 40 c.c. of this reagent until all the mercury is precipitated, this point being determined by testing with ammonium sulphide on filter paper. It was found that 400 mgrms. of mercuric cyanide correspond to 100 mgrms. of reducing sugars.

Reference is made to the outbreak of war between France and Germany, which as in 1914 commenced as soon as the corn harvest had been reaped. The then European beet crop was about 802,000 tons, of which France produced 285,000 and Germany 215,000 tons. The opinion was expressed that if the war was prolonged, an improvement in the price of sugar would most likely be one of the results. Certain French beet factories were in the area invaded by the Germans, but apprehension was confined to the fear that the beet fields would be trampled down or the beets used as fodder for German horses. The destruction of the sugar factories themselves was seemingly not thought of in those days. Current French opinion, as expressed by the *Journal des Fabricants de Sucre* of that day, was that, as a result of the outbreak of war, "German sugar will cease to compete with us in the English markets, which it can no longer reach except by a costly circuitous route, the blockade of the Prussian ports being in all probability very effective."

Among other articles appearing in this number were "The Imphee (*Holcus saccharatus*) or Planters' Friend" by HY. S. OLCOTT, giving a highly laudatory account of the value of this plant; "Practical Observations on Cane Manure" by Dr. T. L. PHIPSON, dealing with the rôle of nitrogen, potash, lime, and silica in cane cultivation; and "The Absorptive Power of Soil" by ROBERT WARRINGTON, being an interesting exposition of the well-known experiments made by WAY on the retention of plant nutrients by the various constituents of the soil. Soluble salts, as ammonium or potassium sulphate, are not washed out of soil, as one might expect they would be, but are fixed. In becoming absorbed they displace another constituent, calcium, for example. WAY showed that the quantities of ammonia absorbed in this way, and of calcium displaced, are equivalent. A review was given of Sir HENRY CROOKES' book "On the Manufacture of Beetroot Sugar in England and Ireland," which was written as the result of the author's long-formed conviction that the introduction of the beet sugar industry "would be a subject of great national importance." Lastly, an abstract was given of the patent taken out by W. HOSACK[1] of Montpelier, Jamaica, for a method of evaporating sugar juices when the liquid is caused to fall in a finely divided state of drops, sprays, or jets.

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[1] English Patent, 283 of 1864; see *I.S.J.*, 1920, 12.

[2] *Liebig's Annalen*, 1870, 154, 252-254.

Agricultural Notes.

The vitality of cane seed.—The seed of the sugar cane is, to all intents and purposes, similar to that of wheat, barley, and many cultivated and wild members of the grass family. It is very small, but with a little care it may be readily obtained in the following manner. Cut the arrow as soon as the feathery florets begin to fly away in the breeze—a sign that the arrow is ripe—detach the branchlets, and crumple up the mass in the hand and place it in a linen bag. After about a week, carefully rub the mass between the fingers on to a large, clean piece of paper, when the small seeds can be easily made out, inside the transparent chaffy scales, as short dark lines about 1·5 mm. long and 0·5 mm. broad. The seed of each variety or individual arrow may be preserved in a small corked bottle and kept in a dry place. The vitality of cane seed is usually considered to be very low, but this is probably not the case, considering its minute size, if ordinary care is taken to protect it from drying up.

In order to test this vitality, the seed may be sown in earthenware pans, a convenient size of which is one foot across and three inches deep. These pans should be filled with a mixture of equal parts of river sand and powdered horse manure. The latter should be completely freed from grass seeds by watering and exposing in a thin layer. When the grasses have germinated and been duly removed, the manure may be dried again and stored for future use. It is not necessary to take the trouble to sow definite numbers of seeds in the pans: it is doubtful indeed whether, by separating them from their enclosing scales, they may not be injured or dried up. What we want to know is the length of time after collection that the seeds still retain their germinating capacity, and for this purpose it will suffice to sow equal parts by weight of the arrow mass, at intervals of a fortnight or month. But the arrows must be broken up into quite small tufts to remove the thicker stalks, and also well mixed, because the number of seeds in the upper and lower parts of the arrow differs considerably. Weigh out a definite quantity of the mixed mass and spread it evenly over the surface of the pan, then water it lightly from a fine rose-can, and the fluffy hairs will adhere to the soil and not be blown away with the breeze; afterwards, keep the pans in full sunshine and water in a similar manner twice daily.

The first germinations take place within three or four days of sowing, and the tiny plants are removed day by day as they appear, a record being kept of all such removals. The sowings should be continued at intervals until no more germinations take place. That the vitality of the seed is often considerable may be seen from the accompanying table, which gives the results of an experiment with monthly sowings made at the Cane-breeding Station at Coimbatore in 1914-15.[2]

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[1] English Patent, 2144 of 1869.

[2] C. A. BARBER, Studies in Indian Sugar Canes, No 2. Memoirs of the Department of Agriculture in India, Botanical Series, VIII, 3, 1916, page 127.

Variety.	Date of collection.	Germination test.	Feb. 1	Mar. 1	Apl 1	June 1	July 1	Aug. 1
Madras No. 2	9th Dec., 1914	500	500	300	200	100	20	0
Madras No. 6	15th Dec., ,,	500	500	300	200	100	20	0
Saretha	14th Dec., ,,	500	500	500	300	200	40	0
Java	4th Jan., 1915	500	500	300	100	50	0	0
B 208	5th Jan., ,,	500	500	300	less than 100	12	5	0
Striped Mauritius	5th Jan., ,,	200	200	100	50	12	0	0

Equal quantities of pounded arrow were sown in the first five, a less quantity being available in Striped Mauritius.

The arrows were collected from the 9th December to the 4th January and tested for germination before the experimental sowings commenced. Sowings were then made on the first of each month, with the exception of May, until August, when, no germinations resulting, it was assumed that the seeds remaining had died. Some of the cane seed was capable of germination seven months after collection. Saretha and the two Madras seedlings showed most vitality and the thick tropical canes least, but even in the latter much of the seed retained its life for four months. From this it appears that it should be quite easy to send cane seed from one end of the world to the other without injury, probably best in the arrow itself.

On one-bud planting.—A worker has recently claimed that a greater mass of canes to the acre can be obtained by planting only one bud of each set and placing the set so that this bud faces upwards.[1] He goes a step further. He also asserts that, as the result of experiment, by removing all the lateral branches and allowing only the mother cane to grow, a much more uniform crop can be obtained of thick canes which all ripen together, an obvious advantage in harvesting. But we confess that we are not convinced as to the soundness of this practice in the field. Let alone the great amount of troublesome work in planting, the number of sets must be enormously increased if each one is only allowed to produce one cane. There may perhaps be something to be said for allowing only one bud to grow from each set, for by this means we should, theoretically, be able to obtain a set of plants unhampered in their growth by a struggle with near neighbours. Healthier plants will undoubtedly be produced. In planting single-bud sets a more careful scrutiny of the planted material will be necessary, and it is well known that many diseases are propagated in the fields by careless selection of the plant cuttings. It has recently been demonstrated that, by planting only one seedling of paddy (the rice plant) in each hole, instead of the time-honoured bunch of seedlings, a better outturn of rice is frequently obtained; but with the allied sugar cane we must reserve our opinion, as it is a matter which the practical planter must settle for himself. The subject has been introduced here, merely to indicate that, in the working of the fields, there is plenty of room for a study of the underground branching system of the cane plant, and that time-honoured customs need not of necessity always be the best. There is any amount of scope here and elsewhere for the thoughtful planter to conduct simple experiments of this nature.

C.A.B.

No reliable statistics are available to show the annual production in Venezuela of either *papelon* or white sugar. The most reliable estimates would seem to show that there are under cultivation at the present day about 26,000 acres of cane, yielding about 30,000 tons of sugar. In 1918, 12,000 tons of sugar were exported, chiefly to the Dutch West Indies.

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[1] KULKARNI, M. L., Experiments in planting Sugar Cane Sets with Single Eye-buds, etc. *Agricultural Journal of India*, Special Science Congress Number, 1918.

The Sugar Production in Cuba for the 1919-20 Crop.

(From our Correspondent.)

The present Cuban sugar crop is now drawing to a close, and the figures we have at hand are ample to give us a good idea of what the tonnage made will be. Before the crop commenced the prospects looked good, and it was generally believed that another record in production would be achieved. Several statisticians published estimates varying from 4,200,000 to 4,500,000 tons in round figures. From all accounts it certainly looked at one time as though the crop would lie somewhere between those figures. However, the harvesting had not gone far when reports began to be current of a disappointing tonnage of cane, and the evidence became increasingly strong that the original estimates of output would not be reached. This fact was mentioned in our April issue.

We now give the figures of 149 mills that have finished their crop, and show the "estimated" and the actual amount produced by Provinces.

PROVINCE.	Number of mills.	Estimated number of bags.	Produced number of bags.	Per cent. under estimate.
Pinar del Rio	4	315,000	285,569	9·3
Habana	16	2,640,000	2,313,639	12·3
Matanzas	32	5,188,000	4,223,451	18·5
Santa Clara	46	5,960,000	5,070,296	14·9
Camaguey	18	5,775,000	5,039,243	12·7
Oriente	33	4,443,000	3,744,474	15·7
	149	24,321,000	20,676,662	15 per cent. nearly.

There are still a number of mills grinding and they are distributed as follows: Pinar del Rio, 5; Habana, 2; Matanzas, 3; Santa Clara, 15; Camaguey, 5; Oriente, 13; in all 43.

We therefore see that out of a total of 192 mills, 149 have finished their crops with a combined production of about 15 per cent. under their estimates. The remaining 43 mills, we know, will not change that figure to any appreciable extent, so that we can safely state that the Cuban sugar crop will be 15 per cent. under the estimate, which will give us a total of about 3,750,000 tons, a lower output than the crop of 1918-1919. Twenty-three mills have produced more than their estimates, the rest are all under, by various amounts, one as much as 47 per cent.

The figures of work done by a number of mills are given in the table on next page; from this we can see that some mills are doing very excellent work, while others, considering the good machinery they have, are achieving results of a very poor quality. The table makes quite an interesting study, and shows up very clearly the weak and strong points of the various mills.

THE OUTLOOK FOR 1920-21.

With the exception, perhaps, of the eastern part of the Island, the spring weather has been very favourable. Ample rains have fallen in most districts, and as they came early, ratoon canes generally are looking well and are far advanced. Moreover, spring plantings that were done with the earliest rains, are coming on vigorously. With a continuation of this favourable weather, the prospects for a big and record crop are certainly good, for large new areas are planted, and in preparation for planting, and the whole country has a very healthy and prosperous appearance. So though it is too early yet to make an estimate, with any degree of certainty, of Cuba's crop for 1920-21, we may rest assured that the prospects point to a record outturn.

Factory.	General Efficiency.	Efficiency of Manufacture or Boiling House recovery.	Mill Extraction per cent. Sucrose in cane.	Extraction Normal Juice.	Purity Final Molasses.	Commercial Sugar per cent. Cane.	Per cent. Sucrose in Cane.	Imbibition.	Purity Normal Juice.	Days Grinding.	Boiling House Efficiency number.
1	88·81	93·04	95·45	83·27	28·0	13·01	14·06	36·4	84·36	92	100·27
2	87·20	92·34	94·43	82·20	28·8	11·33	12·53	25·0	82·10	113	101·13
3	86·34	91·84	94·01	80·89	35·5	11·91	13·23	8·9	84·98	82	100·08
4	85·53	90·11	94·92	83·54	35·7	12·13	13·65	27·0	81·55	..	99·07
5	85·35	91·42	93·36	81·84	32·1	10·93	12·29	21·7	81·81	78	100·34
6	85·15	92·64	91·92	79·67	33·4	11·25	12·68	13·3	83·23	..	100·76
7	85·09	90·42	93·94	80·63	37·3	10·52	11·87	7·5	81·57	64	99·40
8	85·04	95·33	89·20	78·92	23·9	13·03	14·71	25·3	85·08	55	102·51
9	84·88	93·35	90·92	79·00	29·2	12·11	13·70	11·3	83·23	82	101·53
10	84·78	91·98	93·69	81·48	38·1	12·12	13·72	24·8	83·05	60	100·15
11	84·61	91·63	92·34	74·93	29·5	11·60	13·20	..	84·16	98	99·16
12	84·42	91·95	91·81	80·89	31·2	12·08	13·73	19·3	84·46	56	99·25
13	84·42	91·21	92·56	80·73	31·3	11·38	12·95	18·5	82·39	93	99·73
14	83·78	89·12	94·00	81·08	32·9	11·68	13·38	19·6	83·18	77	96·96
15	83·74	88·85	94·28	82·24	41·5	12·72	14·58	34·6	83·84	59	96·27
16	83·72	91·62	91·40	79·47	31·5	10·72	12·30	21·3	81·43	89	100·81
17	83·69	91·18	91·78	79·23	30·8	10·96	12·57	17·4	82·98	90	99·33
18	83·62	90·37	92·53	78·82	32·1	9·92	11·39	5·3	85·04	60	97·21
19	83·60	89·72	93·09	82·05	37·6	12·25	14·09	19·0	83·84	69	97·21
20	83·58	88·73	94·20	81·58	33·6	11·71	13·45	21·5	82·64	61	96·85
21	83·47	90·55	92·18	79·33	32·1	12·08	13·61	12·4	84·58	72	97·67
22	83·37	90·32	92·30	78·97	31·8	10·87	12·51	15·2	82·31	79	98·82
23	83·00	88·85	93·42	80·62	35·2	10·62	12·30	18·4	80·72	82	98·70
24	82·85	91·14	90·90	79·52	32·7	11·36	13·16	21·5	83·25	95	99·10
25	82·89	91·47	90·62	79·12	30·9	10·72	12·41	8·8	81·61	97	100·54
26	82·78	91·39	90·61	79·69	29·6	11·26	13·07	14·6	84·10	91	98·86
27	82·74	92·24	89·75	76·48	30·8	12·20	14·19	7·2	81·07	76	101·73
28	82·54	90·72	90·98	77·46	36·0	11·08	12·96	12·8	83·38	66	98·57
29	82·46	90·00	91·59	77·30	30·0	11·17	12·83	18·4	84·30	82	97·18
30	82·39	89·53	92·03	79·74	33·8	11·07	12·90	12·9	81·52	76	98·46
31	82·39	89·25	92·31	80·36	33·0	11·31	13·18	27·7	82·58	66	97·48
32	82·33	90·78	90·70	78·04	34·0	10·57	12·33	11·0	83·10	86	98·81
33	82·18	89·75	91·56	79·99	33·0	11·51	13·44	10·0	85·07	..	96·53
34	82·16	90·31	90·98	76·61	32·7	10·85	12·68	18·5	81·83	90	99·12
35	82·02	87·78	93·87	80·80	34·5	9·70	11·35	18·3	80·89	92	96·93
36	81·92	88·54	92·52	81·78	34·0	11·30	13·35	15·7	79·25	70	98·89
37	81·20	89·25	90·98	76·95	36·6	11·52	13·63	22·2	82·31	87	97·66
38	80·31	89·67	89·56	78·19	32·5	10·29	12·30	10·6	81·04	72	98·95
39	79·92	87·42	91·42	78·76	35·4	9·46	11·36	22·8	81·21	76	96·34
40	79·67	90·03	88·49	78·13	32·2	10·92	13·16	12·1	80·52	90	99·77
41	79·62	85·57	93·03	79·11	35·7	11·18	13·48	19·2	82·31	77	93·63
42	79·35	87·99	90·27	77·82	39·3	11·17	13·37	7·5	82·34	61	97·16
43	78·90	88·24	89·37	75·72	34·4	12·13	14·75	19·5	84·66	65	95·13
44	78·86	89·05	83·56	75·83	37·8	10·72	13·25	15·5	84·10	77	96·33
45	76·80	88·58	86·69	74·54	35·0	9·78	12·23	17·5	81·09	62	97·69

NOTE —Placed in order of "General Efficiency of Mill."

Examinations in Sugar Manufacture.

For the purpose of encouraging the attainment of a certain standard of proficiency in technological subjects, examinations are conducted annually by the City and Guilds of London Institute. During the war the number of entries for the examination in Sugar Manufacture was unfortunately too small to justify the Institute in holding these examinations, notwithstanding the fact that the regulations only require a minimum of ten candidates in the aggregate for any one grade of a subject, or of five candidates from a class registered with the Institute. It is hoped that the number of entries may now be sufficient for the examinations to be resumed. In that case the next examination will take place on Tuesday, April 26th, 1921.

In the past, the examination in Sugar Manufacture has been taken by candidates who have been assistants employed by refiners, confectioners, and brewer's sugar manufacturers in the United Kingdom. The certificates granted to successful candidates have come to be regarded as a useful qualification for the young sugar chemist, and there has been keen competition for the medals[1] which are offered to candidates obtaining the highest number of marks in the examination (provided that these are not teachers).

Attention is also directed to the fact that the Institute's examinations are held in India and in many of the Overseas Dominions and in some Colonies, so that candidates residing in any part of the Empire can usually arrange to present themselves. Arrangements could probably be made through the Directors of Education for the Dominion or Colony for the examination to be held at centres in South Africa, Australia, the West Indies, Mauritius, India, and Hong Kong.

In the past the examinations have been held in two grades, known as Grade I, and the Final Examination. But by an agreement recently concluded between the Board of Education and the Institute, only the Final examination will be held in future at centres in England and Wales, it being expected that examinations required of a lower standard will be conducted by the Authorities of technical schools. In Scotland, Ireland and Overseas, however, the examinations will continue to be held in both grades if there are a sufficient number of candidates as indicated above. Candidates in the United Kingdom should in general make arrangements for their accommodation for examination through the Authorities of the technical school in the town in which they reside, and those desirous of entering at centres Overseas should communicate with the local Director of Education. If any candidates desirous of entering are unable to arrange for their accommodation for examination in this way, they should communicate before the end of the year with the Superintendent, City and Guilds of London Institute, Department of Technology, Exhibition Road, South Kensington, London, S.W. 7, who will endeavour to suggest the name of the nearest school at which they may possibly be able to obtain accommodation.

The fee for the examination in Grade I is 3s., and for the Final examination 6s. All entries should be in the hands of Local Secretaries in the United Kingdom by March 9th; but entries from candidates Overseas should be made before the end of the year.

Syllabus.[2]

In Grade I the examination will include questions founded on such subjects as the following:—

1. Cane sugar; its occurrence in nature. 2. Methods of extracting the juices of sugar-yielding plants; composition of the juice so extracted. 3. The principal methods

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[1] Bronze in Grade I, and Silver in the Final. [2] This Syllabus is now under revision.

of making raw sugar from these juices, and the apparatus employed, including the vacuum pan, multiple effect pans, and "concretor." 4. Refining of raw sugar. *Practical* details of melting and bag washing and boiling *in vacuo*. 5. Treatment of the boiled mass for the preparation of "loaf sugar," "crystals" and "pieces" (crushed) respectively. 6. Treatment of the syrup to secure the extraction of the last available portions of sugar. 7. Molasses or treacle, composition and nature of. 8. Animal charcoal; its preparation, composition, revivification, and action on cane and beet juice and solutions of raw sugar. 9. The centrifugal machine, general construction of some of the principal forms of; method of using, and explanation of its action. 10. Apparatus and machinery in general use in sugar factories and refineries.

In the Final Examination more difficult questions will be set in the above subjects, and in addition a knowledge will be required of :—

1. Analysis and valuation of raw sugars and syrups; construction and principle of the instruments required; and the preparation and standardizing of the reagents employed. 2. The chemistry of cane sugar; its composition, properties, and changes under the action of heat, acids, and ferments. 3. Glucose, its properties and its relation to cane sugar, distinguishing between dextrose and levulose. 4. The chemistry of animal charcoal. 5. The physics of the vacuum pan (involving properties of steam).

Manufacture of "Whole Juice Sugar" (Sucre Complet).

Mr. Paul Kestner claims[1] to have discovered a process of manufacturing directly from beet juice a raw sugar of good taste, somewhat similar to *arreado*; that is, a fine mealy product, which, owing to its extremely small grain, imparts to the palate a greater sweetness than ordinary crystals. It contains about 90 per cent. of sugar. It is hygroscopic; but, as it is capable of absorbing a quantity of water without seeming moist, it can be exposed for a reasonable time to humid air without any apparent alteration of condition.

The method of eliminating the disagreeable flavour inherent in beet products consists simply in raising the temperature of the juice to a rather high degree for a short time.[2] The product thus made is said to meet many of the requirements of the chocolate, biscuit, and confectionery industries. It may even be consumed directly, and is stated to give an improved taste to *café noir* and *café au lait*, but it darkens tea and fruits that are light in colour. A possible defect is its great lightness, its density being only about half that of ordinary sugar; but it should be feasible to produce it in blocks if desired (thus obtaining beet concrete sugar).

This *sucre complet* ("whole juice sugar," analogous to *pain complet*) is claimed to have a greater food value than ordinary sugar, owing to the nitrogenous substances and the salts its contains. It may advantageously be mixed with cocoa[3] and with condensed milk to form nourishing and palatable products.

In order to manufacture this "whole juice sugar," and assist in re-establishing that part of the French sugar industry devastated during the war, Mr. Kestner advocates the cultivation of the beet in parts where hitherto it has not been grown to any large extent, viz., the west and south-west. About 2500 tons of roots are obtained from 90 hectares (about 11 tons per acre), and at a convenient centre a small *sucrerie* could be erected to turn out 450 tons of "white sugar juice" containing 82 per cent. of sucrose, or 430 tons with 90 per cent. of sucrose (the richness of the roots being 17 per cent.), 16 per cent. being recovered as manufactured product. No molasses would thus be obtained, and the only by-product would be beet pulp, as in the usual course of affairs.

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[1] *Journal des Fabricants de Sucre*, 1920, 61, No. 5.

[2] U.K. Patent, 135,235; *I S.J.*, 1920, 115.

[3] U.K. Patent, 136,205; *I.S.J.*, 1920, 289.

Mr. J. WEISBERG, a well-known French technologist,[1] is of the opinion that Mr. KESTNER has solved the problem of making an agreeable product without previous clarification from beet juice, although the latter possesses a taste and odour *sui generis* rendering it unsuitable for conversion into direct consumption sugar. This elimination of taste and odour at a high temperature can easily be explained, being caused by the conversion of the obnoxious bodies under the influence of heat into substances that are not unpleasant in flavour. Moreover, owing to the natural acidity of the juice, and the high temperature to which it is raised, a certain amount of sugar is inverted, and this certainly contributes to the satisfactory result, a product being obtained somewhat (it is said) resembling honey.

Mr. KESTNER, however, had a precursor in this direction in the person of Prof. HERZFELD, of Berlin, who during the war concentrated beet diffusion juice treated with a little mineral acid to the state of a thick syrup, which thus was partly inverted, and which possessed a sufficiently agreeable taste to make it suitable for direct consumption. That Mr. KESTNER can manufacture "whole juice sugar" of good taste may be taken as an incontestable fact, Mr. WEISBERG thinks; and it is only the question of hygroscopicity that need be examined. It will be necessary, for example, to determine whether the chocolate, powder, biscuits, etc., made with the new product will keep as well as those made from white sugar. In any case it would be well, Mr. WEISBERG adds, if a certain number of French factories would arrange to manufacture a quantity of fine white granulated, as is done in America. "Ce que peut faire la jeune Amérique, la vielle France pourrait trés bien le faire aussi . . . ."

Prof. LINDET,[2] Member of the Institute, outlined the process in a recent lecture. Diffusion juice is heated with half the quantity of lime (in the form of powder or milk) ordinarily employed; filtered; and evaporated at 120–125°C. A slightly alkaline syrup is thus obtained, which is neutralized with phosphoric acid, and evaporated almost to the consistency of mastic, using a temperature of 130°C., under which degree of heat the "beety" taste disappears. On cooling the syrup, crystallization takes place, the whole mass assuming the appearance of aerated sugar. Carbonatation, sulphitation, centrifuging, and the working-up of the low products are all thus eliminated with the consequent saving of much labour and plant. One of the audience raised the question of the extra cost of the fuel required for evaporating at 130°C., as compared with the ordinary operation *in vacuo*. This is a point yet to be studied.

In another article on this subject,[3] Mr. KESTNER replied to possible critics by insisting that the "whole juice process" would by no means compete with the sugar industry as at present constituted, and that existing factories would certainly not be affected. The process is one that should be of considerable interest for countries not making sugar (as England), since at 50 or 100 localities small factories could be installed around which 200–300 hectares (450 to 650 acres) of beet would be under cultivation. It has been installed at the Pithiviers factory, France, and two methods of treatment have been under study side by side. Which procedure is in general the better will be decided during the approaching campaign.

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[1] *Journal des Fabricants de Sucre*, 1920, 61, No. 7.
[2] *Comptes rendus des seances de l'Academie d'Agriculture*, 1920, 6, 291.
[3] *Journal des Fabricants de Sucre*, 1920, 61, No. 12.

The Growth of the Sugar Cane.[1]

By C. A. BARBER, C.I.E., Sc.D., F.L.S.

VIII.

Differing radically from the length of the cane, the thickness is, within certain limits, fixed for each variety. We have thick, medium and thin forms and the thickness attained by individual canes is not nearly so much influenced by climatic and other external conditions as is their length, which we discussed in last month's paper. An ordinary sugar cane in the field will have a thickness of from 1½ to 2 inches, but there are two classes in which these limits are overstepped. Here and there throughout the sugar belts we meet with very thick-stemmed varieties, sometimes distinguished as "elephant" canes. Taking the Tanna series as examples, the following are characters which distinguish them. They do not grow too tall for ease in reaping, do not fall easily and are markedly resistent to the commoner cane diseases: there are comparatively few canes in the bunch but the tonnage is good; they are self-cleaning, in that the dead leaves readily fall off. On the other hand, the juice is rather poor and elephant canes are not usually in much favour on the estates: they are sometimes found troublesome in the mill because of their great thickness. This is of course especially the case with the primitive bullock crushing mills, where it is not uncommon for the canes to be sliced in half before pushing between the rollers, owing to the heavy work devolving on the cattle. In spite of these disadvantages, the Tanna canes appear to have been received with favour in certain localities and the yield is often very heavy. In parts of Bengal and Bihar, where lodging is a serious drawback in the light alluvial soils, especially when the fields are flooded by the monsoon rains, these canes can be seen standing up handsome and pillar-like among the falling thinner varieties. Elephant canes, which are usually from two to three inches in thickness, are an interesting class but cannot be regarded as in any sense the climax of selective development. It is, indeed, arguable that, among the cane varieties most valued on estates, the trend is rather in favour of the thinner than the thicker forms, a point of view to which we shall refer later on.

In marked contrast to the elephant canes are the varieties indigenous in India. Although a few of these, such as Mojorah of Assam, may rival in thickness the tropical varieties, it is usual to designate the latter as the "thick cane" series. Most Indian canes are well under an inch in thickness and some are very much thinner. For instance, it is probable that the great bulk of the canes reaped from the 400,000 acres of sugar cane in the Punjab are distinctly less than half an inch in diameter, besides having a thick, tough rind and much fibre. Indian canes are frequently classified under three classes, Ukh, Ganna and Paunda, although this classification is more suitable to the canes in the United Provinces (where it arose) than elsewhere. The Paunda canes are from 1½ to 2 inches in diameter and are probably all introduced tropical canes, some of them having been in the country for a long period. The Ukh varieties form the mass of canes grown in the north of India and are present in an enormous number of varieties separable into several great groups. They are, like the Punjab canes, thin and fibrous, but the juice such as there is of it is sweet. Between these two classes are the Ganna canes, generally from one half to one inch in diameter, with less fibre and more juice than the Ukh canes, but this juice of a poorer quality:

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[1] The previous articles of this series appeared in our issues of October, November, December, 1919, February, April, June, and July, 1920.

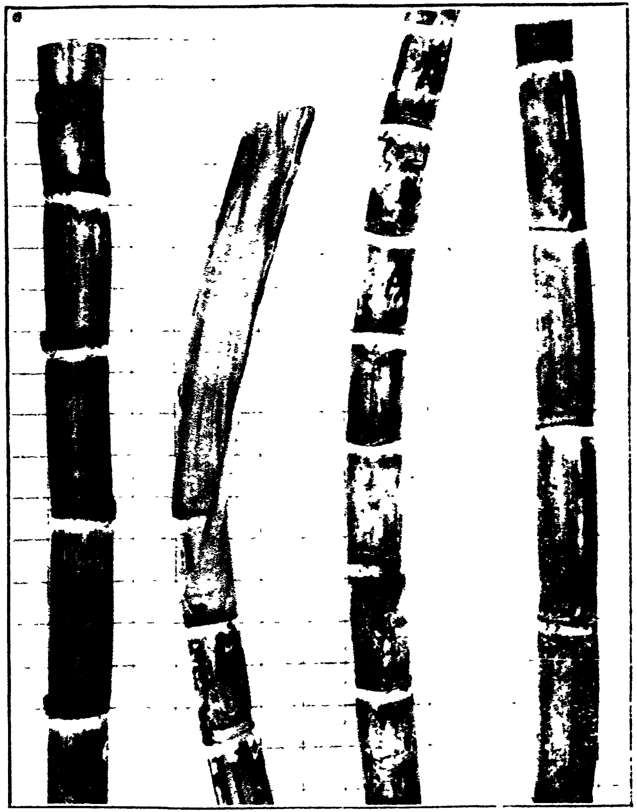

FIG. 1.—Chittan Cane from Madras

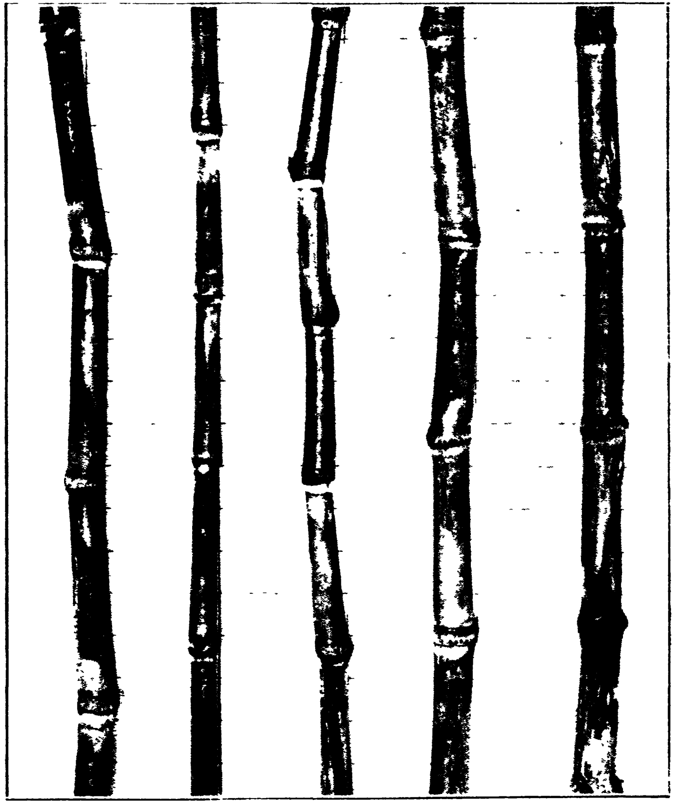

FIG. 2.—Pansahi Cane from Bengal

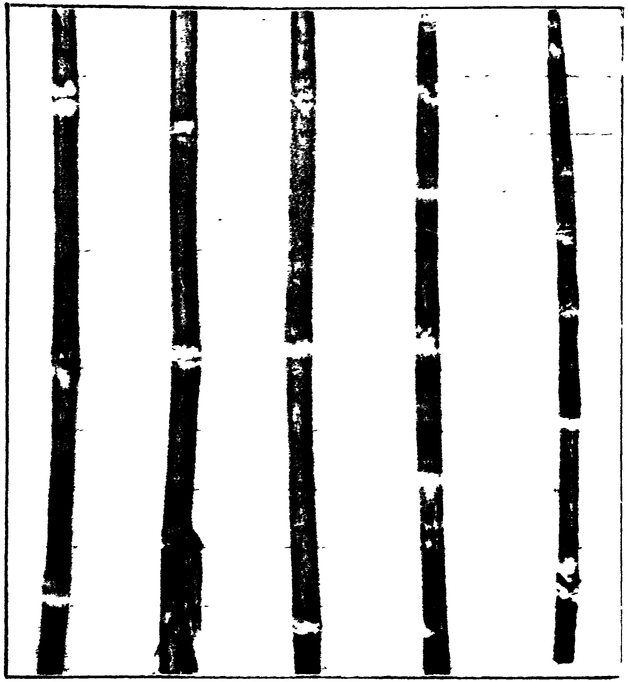

Fig. 3—Katha Cane from the Punjab

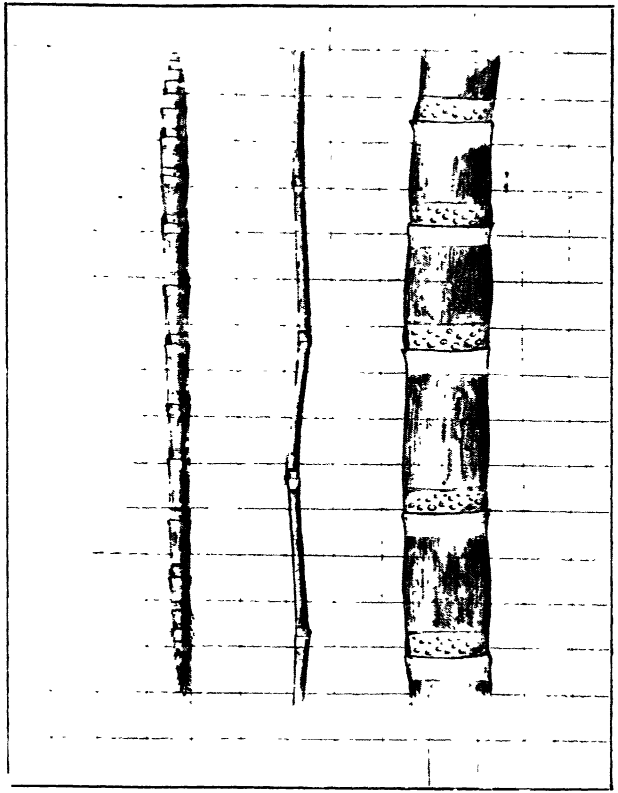

Fig. 4—Some tiny Ukh Canes taken from the mill yard, compared with a Paunda Cane

they are, further, less hardy and more liable to diseases such as red rot, and in consequence have greatly diminished in favour during the last half century. They belong to several well defined groups, of which the most interesting from our point of view is the Pansahi, with perhaps twenty varieties, for to it undoubtedly belong the Uba cane of Natal and the similar varieties of South America, though how and when they were transferred from India has not as yet been determined.

This opportunity is taken to illustrate the relative size of the typical Paunda, Ganna and Ukh canes grown in India. Figure 4 is added to show what tiny specimens are occasionally crushed in the mills. All the pictures are drawn or photographed on inch squares. Figure 1 is of a Chittan cane from Madras, a typical Indian Paunda variety. Figure 2 is of Pansahi from Bengal, a typical Ganna cane. Figure 3 is one of Katha from the Punjab: an average cane of the main Ukh variety grown in the tract. Figure 4, lastly, shows some canes collected by the writer from the mill yard in India. On the right is a specimen of the ordinary Paunda canes grown. In the middle is an Ukh specimen collected in North India: it was not an average cane, but one of many of similar diameter being crushed. On the left is an *average* specimen taken from a ton of canes just arrived at the mill from a poor field of ratoons: it measured, all over, from base to apex, only 14 inches and was collected because of its unusually meagre proportions. One specimen only 8 inches long was at first taken off the cart, but was rejected as distinctly below the average. It seems strange that it should be worth while to crush such canes, but I was interested to learn that the season's work turned out to be very profitable to the mill concerned.

Taking thickness into consideration, there is yet another class of canes which deserves mention here, namely the seedling canes which have been obtained during recent years by crossing thick tropical forms with the thin Indian canes. Such are the Java seedlings Nos. 33, 36, 139, 213 and so on, obtained by crossing Cheribon with Chunnee, hardy, free tillering, thin canes which have met with much acceptance in places where the climate is unsuitable for the growth of the more delicate tropical kinds, especially in Argentina and different parts of India. Many similar crosses between indigenous Indian canes and those of the tropics have recently been raised at the Cane-breeding Station at Coimbatore, and these have now been distributed and are entering into competition with the North Indian forms which they are designed to displace. Lastly, there is a curious set of seedlings, also emanating from Coimbatore, which closely resemble these crosses but have apparently no Indian blood in them. Whenever large blocks of thick cane seedlings have been raised, one or two have been noted with much thinner stems, but amazing vigour and hardiness though poor in juice withal. In spite of the last named defect, they have been carefully reproduced and have been largely used to cross with thick canes to obtain a special blend of hardiness with moderately good juice. Some of the seedlings thus raised are among the most promising which the Station has sent out. Owing to their peculiar and little understood mode of origin these aberrant seedlings have been termed "rogues."

Turning to the growth in thickness of the individual sugar cane, we have seen in former papers that each stalk arises from a bud and is extremely thin at its junction with the parent stem.[1] The joints, once formed, do not themselves increase in thickness, and for this to take place in the cane each succeeding joint is broader than its predecessor until the thickness usual for the variety has been attained; after that the new joints remain of this thickness but greatly increase in length so that the cane is pushed up pillar-like without any alteration in its diameter. In this matter the cane resembles the palms, whose tall stems are usually of a uniform thickness all the way up. There is no secondary thickening of the stem such as we are accustomed to in the trees of temperate regions, owing to the absence of any cambium layer. Toward the summit of the cane the thickness rapidly diminishes among the immature joints and the cane ends in a conical apex. We can thus prepare a section of the whole cane and compare it with a cylindrical rod with pointed ends. (*See* Fig. 4.)

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[1] See *I.S.J.* 1919, page 509 and fig. 9, and 1920, page 313.

But while this may be taken as the normal course of events, a more detailed study of the thickness of the cane in different parts shows certain exceptions. The first formed canes of a bunch are often thinner in their lower part and become gradually thicker upwards, sometimes ending club-like before the final narrowing at the apex. On the other hand, the latest formed canes of the clump are often enormously thickened at the base and quickly narrow upwards. This latter peculiarity is specially met with in those abnormally thick late shoots which have not time to ripen before harvest and are termed gourmandizers or water shoots. Most canes, furthermore, are not strictly cylindrical, but oval in section, being wider in the median plane (that in which the row of buds lies) than in the lateral. And an extreme case of ovalness has been met with in certain varieties, in that the basal part of the cane is literally flattened out, and in the lateral instead of the median plan, and does not reach its comparatively cylindrical form for some way up. Such exceptions need not interfere with our general conception of the growth in thickness and form of the cane, and are merely mentioned here to emphasize the point that, in every case where detailed study is made of any natural phenomenon, exceptions are found which are paradoxically claimed to "prove the rule" by their very rarity.[1]

In the opening sentence of this article we spoke of "certain limits" within which the normal thickness of the canes in any one kind of cane will vary. Everybody watching the canes passing up the carrier to the mill will have noted that, while there is a general average thickness in each kind of cane, many isolated canes either exceed or fall short of it. The cause of this constant variation has been somewhat fully explained in previous papers of this series (see especially *I.S.J.*, 1920, pp. 200-201 and the figures on the accompanying Plate). Stating the case briefly, we know, from our dissections of the branching system of the cane plant, that those first appearing are usually the thinnest and that the later formed branches are thicker and thicker according to the order of branching they represent in the clump complex. With the normal thickness of the variety in one's mind it is thus easy, at the mill, to separate the canes into those formed in the early and late parts of the season. And the limits of variation around the normal or average will depend upon the formula of the branching system,[2] being wide in the case of canes with an extended formula, such as the Indian canes, and narrower where, as in the tropical forms, there are fewer canes in the bunch and the formula has fewer orders of branching.

We have thus far considered the thickness of the cane as a whole and studied its variations in different parts, assuming that each joint is uniform throughout its length. This is, of course, not the case. While the joints of some canes are almost uniformly cylindrical, those of others differ in thickness in different parts of the length, this giving them a characteristic *shape*. In some canes the joint is thickest at the node, and it becomes bone-shaped or biconcave; in others the joints are thickest in the middle and are biconvex or barrel-shaped. Sometimes the base of the joint is thickest and the rest tapers upwards, and sometimes the reverse is the case; and there are endless minor variations of these main types. The interesting feature in these joint shapes is that they are usually constant for the variety, and we have some reason to believe that the shape of the joint is one of those few characters of the cane which we know are handed down from parent to offspring.[1] The shape of the joint has already been found useful in determining the male parentage of an unbagged seedling, when several adjoining plants have been in flower together. Fig. 5 shows some typical shapes of cane joints.

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[1] C. A. BARBER, Studies in Indian Canes, No. IV. Memoirs of the Agricultural Department in India. Botanical Series, X, 2, 1919, page 126. See also in the same paper Plate XVII where the usual form of basal thickening of the cane is clearly shown.

[2] *I.S.J.*, 1919, page 602.

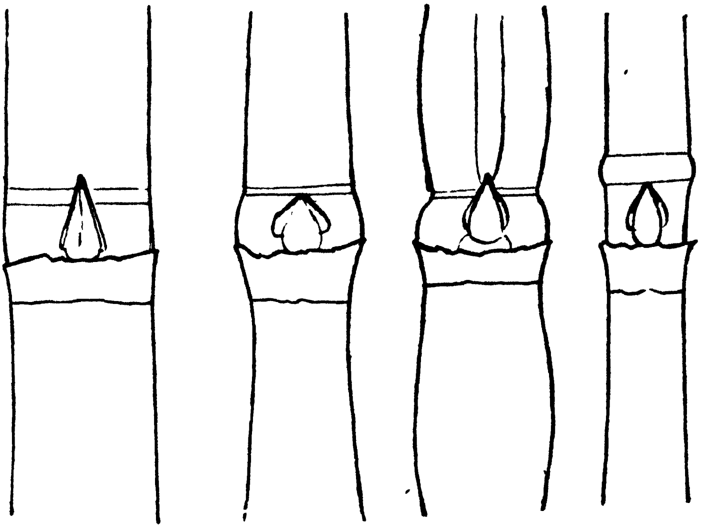

FIG. 5.—SOME SHAPES OF CANE JOINTS.

The thickness of the cane is an important factor in the weight of the crop, and the question naturally arises as to whether we can in any way control it. A good deal of work has been done at various times in planting the cane sets at different distances apart, as influencing amongst other things the weight of the individual canes. Many years ago STUBBS in Louisiana showed that, by planting the sets more widely apart, thicker canes could be obtained. This question has been more exhaustively studied in Java. There it became a matter of some importance to use as few sets as possible per acre, because, at the onset of the sereh disease, the planting material had to be raised in special hill nurseries far from the plantations in the plains. MULLER VON CZERNICKI has published the most useful and comprehensive studies on the subject. His results agree in the main with those of STUBBS as to the effect of spacing, and he showed that for each variety experimented with there is an optimum of cane reaped, which can be obtained by regulating the distance of the cane plants from one another in the rows. This matter of spacing is a suitable subject for experiments by planters, for no general rule can be formulated. The optimum of yield has to be determined for each variety grown, for each soil and treatment, and for all of the various factors influencing cane growth, such as constantly differ from estate to estate and even from field to field. In these days of intensive work in the factory, cultivation is liable to be somewhat neglected, but it is perhaps more by a careful study of the work in the plantation than anything else that the value of the crop can be increased. That the variations in thickness may be considerable is evident from the following data published by the observers quoted above. STUBBS planted his sets 18, 12, and 6 inches apart in the rows, and the resulting average weights of the individual canes at harvest were 2·60, 2·49, and 2·17 lb. respectively. MULLER VON CZERNICKI varied his distances by planting from 8 to 18 sets in the same length of row, and found that the weight of cane in the more sparsely rows exceeded those in the more closely planted by as much as 14 per cent. Although the weight of cane may depend equally on its length and thickness, and measurements of the former are not given by these observers, MULLER VON CZERNICKI carefully measured thousands of canes as to individual thickness, and came to the conclusion that this was the chief factor in the case. All other workers agree that wider spacing produces thicker canes.

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[1] *I.S.J.*, 1920, p. 311.

But, for a true estimate of the value of a crop, we must have some knowledge of the sugar content of the canes at harvest, and many investigators have tackled this problem, unfortunately without knowing the way in which the cane plant was made up. They generally agree that the thicker canes of a crop have the purest juice. But the results here are less convincing; we now know that the thicker canes are those formed towards the end of the season, and that the relative richness of the juice in early and late canes will depend upon the period of growth at which the cane is cut, opening up a further fruitful field for inquiry.[1]

In concluding these remarks on the thickness of the cane, we may add a few words on another problem well worth investigating, namely, have the thicker or thinner varieties of canes the richer juice? We have found that the purity of the juice of seedlings depends directly on that of their parents; the descendants of rich canes will, on the average, have rich juice and the converse. We have also observed that, when canes are crossed, the average sucrose percentage in the juice of the seedlings varies around the mean of that of their parents. In judging the relative richness of the juice of thick and thin varieties, we must therefore confine our comparison to seedlings of the same parentage. As the result of many hundreds of observations we have come to the conclusion that, as a rule, the extremes of each series are worthless from the sugar point of view. Excessively thick or thin seedlings of a series generally have juice considerably poorer than the average. In a general collection of seedlings with common parentage, we have not been able as yet to come to any definite conclusion, although there seems to be a well defined tendency towards the thinner seedlings being slightly richer in juice than the thicker. In crossed seedlings, where a thick, tropical cane has been crossed with a thin Indian one, there is an equally well defined tendency in the opposite direction, the thicker seedlings of the series having slightly richer juice than the thinner.[2]

Prospects for the 1920 sugar crop in Spain are reported to be excellent, and it is estimated that the Sociedad General Azucarera will be able to treat enough beet to produce 90,000 tons of sugar, which compares with the 85,000 tons of the previous crop. A surplus for export is expected and, with the high prices ruling, an unusually prosperous year is promised for the Spanish sugar industry.

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[1] See *I.S.J.*, 1920, p. 202.

[2] This subject has been more fully developed in C. A. BARBER, Studies in Indian Sugar Cane. No. 2. Memoirs of the Agricultural Department in India. Botanical Series, VIII, 3, 1916, pp. 178 9.

Air-Pump Capacities and Incondensible Gas Volumes in Industrial Vacuum-Evaporator Plant.[1]

By EDWARD CORNER.

The rather unfortunate general use of empirical formulæ for the determination of air-pump capacities in evaporator work has led the writer to attempt to lay down in a clear and concise manner the theoretical principles entailed, with practical data and a set of curves, which will enable designers to choose the correct value for any particular case.

Empirical formulæ are undoubtedly most useful in average cases, and under satisfactory conditions designs obtained by their use are good enough for practical purposes, but many cases have occurred in which a fuller knowledge of the root principles would have been of extreme value to the designer, and would undoubtedly have enabled him to produce a more efficient and satisfactory apparatus. It is often remarked by draughtsmen and engineers, who have been connected with more than one firm, how great the variation is between the empirical figure taken in one shop and that taken in another, and the writer is personally acquainted with three different values for the capacity of dry-air pumps, values which differ so greatly that it difficult to explain the fact that these firms are all makers of very satisfactory plants.

Now, empirical formulæ, especially as regards condensation problems, can only be considered accurate or practically accurate between certain limits, *i.e.*, a single value for, say, air-pump capacity cannot be expected to cover all variations of injection temperature, vacuum, or hot-well temperature, and it is essential that in many cases an accurate factor should be obtained, applicable to the particular conditions prevailing.

The possible vacuum in any condenser is directly due to the absolute pressure in the condenser, this absolute pressure being the sum of the partial pressure of water-vapour and air or other incondensible gases present.

According to Dalton's Law, any number of gases enclosed in a vessel will each exert a pressure upon the walls of the vessel equal to the pressure such gas would have exerted had it been present alone, and the total pressure in the vessel is the sum of the partial pressures of all the gases present. Also, each gas occupies the whole space, or in other words, the molecules of the different gasses are intimately mixed.

The temperature prevailing in a condenser is, approximately, that of the outgoing or "tail" water, and it is easily seen that this temperature is the governing factor in fixing the vacuum. It is sometimes thought that the quantity of air relative to steam, entering the condenser, plays an important part in determining the vacuum, but as the ratio of air to steam is always very small, the actual effect can safely be neglected and, in fact, has no influence whatever in the latter part of the condensation, *i.e.*, after the latent heat has been removed. Immediately after condensation of the steam, the ratio of air to vapour becomes very greatly increased, and the partial pressure of the air becomes a very important factor in determining the vacuum, and it is this partial pressure of the air which explains the difference between the vacuum shown on the gauge and the vacuum which one would expect from the relative thermometer reading.

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[1] Reproduced from *Engineering*, 1920, cix., No. 2820.

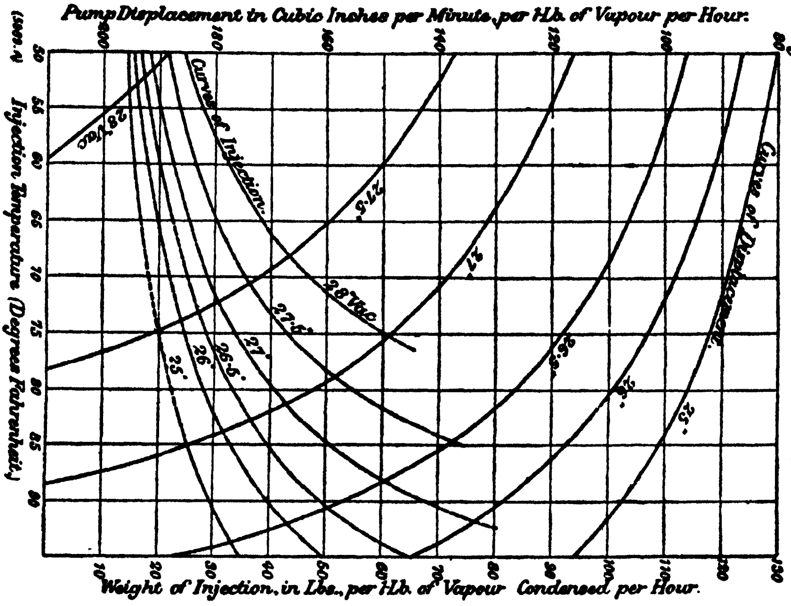


Fig. 1. WET-AIR PUMPS JET CONDENSERS.

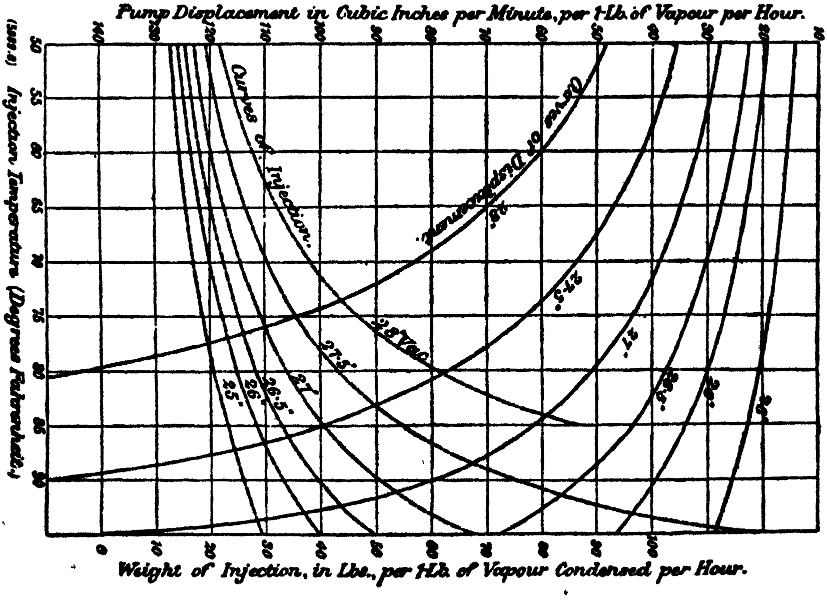


Fig. 2. DRY AIR PUMPS BAROMETER CONDENSERS.

The volume of 1 lb. of air enclosed in a space, at any temperature and pressure, is found as follows:—

$$V_2 = \frac{V_1\,P_1\,(T_2 + 460)}{P_2\,(T_1 + 460)}$$

where V_1 = volume of air in cubic ft. per lb., at 60° F., and 14·7 lbs. per sq. in. = 13·1 cub. ft.

V_2 = volume as above, at P_2 and T_2.

P_1 = 14·7 lbs. per sq. in.

P_2 = Pressure of air at T_2 and volume required.

T_2 = 60° F.

Substituting the given values in the above formula, we get:—

$$V_2 = \frac{13{\cdot}1 \times 14{\cdot}7 \times (T_2 + 460)}{P_2 \times 520} = \frac{0{\cdot}37\,(T_2 + 460)}{P_2}$$

In a mixture of steam and air, at any given volume and temperature, the volume of the air is equal to the volume of the steam, and also equal to the total volume, and its weight is:—

$$W = \frac{p_2 \times V}{0{\cdot}37 \times (T_2 + 460)}$$

where W = weight in lbs. of the air contained in the mixed volume.

P_2 = pressure of the air, which is equal to the total pressure minus the pressure of the water vapour or steam at temperature T_2.

The usual allowances or data for ratio of air to steam, which are applicable to power plant, are very much too low for industrial evaporator work, as this latter plant exposes a much greater joint surface, and is working with liquors which contain a large quantity of gases in solution, as well as other gases which are evolved during the evaporation process. On the other hand, the water used for injection is very often at a much higher temperature than that used in European plant, and thus contains slightly less air; this of course is only intended to apply to tropical conditions, and chemical evaporators working in Europe would, naturally, have conditions of injections similar to power-plant in the same locality.

The most reliable figures for incondensible gas volumes relative to steam entering the condenser are as follows:—

(1) 4 lb. of air per 1,000 lbs. of steam or vapour.
(2) 0·2 lb. of air per 1,000 lbs. of liquor treated.
(3) 0·1 lb. of air per 1,000 lbs. of injection water.

These values are originally intended for sugar-juice evaporators, but can be used with confidence for almost all chemical liquors, and for any temperature of injection. The quantity, under heading (2) above, varies with the number of vessels in the evaporator, and a table of constants is given for the various groupings, as the curves are all calculated for the most usual triple-effect grouping; a set of multipliers is also appended, to facilitate calculation.

As previously mentioned, the possible vacuum in any condenser is directly due to the temperature of the "tail" water, and in condensers of the jet type this tail water is the condensed steam, together with the injection water. The formulæ for obtaining air-pump capacity for any type of jet condenser are very similar, only differing in respect of the values taken for the temperature at which the air is withdrawn, and in the case of barometric or counter-current jet condensers, the pump is not required to deal with any tail water, and thus no factor for this is embodied.

Now, as stated above, the most important factor in determining the possible vacuum is the temperature of the tail water, and indirectly this temperature greatly affects the volume of air which must be withdrawn. Every lb. of injection water brings with it a certain quantity of air, and thus the greater the quantity of injection water used the greater the quantity of air which must be removed. Against this must be placed the fact that, the greater the quantity of injection water used, the lower will be the temperature of the tail water, and consequently a higher vacuum will be obtained, together with a lower air temperature and smaller volume per lb. A set of curves plotted for this purpose shows a marked diminution of air-pump volume, with increase of injection water ratio up to a certain limit, after which pump capacity rises rapidly, on still further increasing this ratio.

To find the ratio $\frac{\text{injection water}}{\text{steam}}$ by weight, the following simple formula is used:

$$W = \frac{L + (T_1 - T_2)}{T_2 - T_3}$$

where W = weight of injection water per lb. of steam per hour.
L = Latent heat of the steam at temperature due to required vacuum or T_1
T_1 = Temperature of steam at the required vacuum.
T_2 = Temperature of the "tail" water.
T_3 = Temperature of the injection.

It is usual to assume T_3, 10° below T_1 for low-level, parallel-flow jet condensers, and 5° below T_1 for barometric or other counter-current jet condensers. These allowances are considered sufficient in most cases, but the designer must satisfy himself, in special cases, that the temperature difference given by these values is sufficient for the complete transmission of the heat during the passage of the steam through the condenser, or in other words, that the condenser is of sufficient length. The curves in Figs. 1 and 2 are plotted for conditions as given above; other conditions will of course require special calculations, of which formulæ are given below in their respective places.

Low-level parallel-flow condensers.—The air which is to be removed from this type of condenser is withdrawn along with the tail water, and is, therefore, practically at the same temperature, and its volume may be calculated as follows:

$$V_2 = \frac{V_1 P_1 (T_2 + 460)}{P_2 (T_4 + 460)}$$

where V_2 = volume of the air, in cub. ft., per lb. at temperature T_2;
P_1 = 14·7 lbs. per sq. in. pressure.
P_2 = Pressure of the air, or difference between total pressure in the condenser and the pressure of water-vapour at temperature T_2
V_1 = 13·1 cub. ft.
T_2 = temperature of the tail water.
T_4 = 60° F.

This formula, as already shown, becomes on substitution:—

$$V_2 = \frac{0{\cdot}37\ (T_2 + 460)}{P_2}$$

The pressures used in condenser work being all below atmospheric pressure, and as temperature is such an important factor, it is found more convenient to take these pressures in inches of mercury rather than in lbs. per sq. in, and the above formula then becomes transformed to:—

$$V_2 = \frac{0{\cdot}37\ (T_2 + 460) \times 2{\cdot}04}{p_2} = \frac{0{\cdot}755\ (T_2 + 460)}{p_2}$$

The formula given above enables one to calculate the volume of 1 lb. of air at any temperature or pressure, but in order to obtain the pump displacement, it will be necessary to revise the above so as to give the volume of air and tail water per lb. of steam, and as pump displacement is usually given as cub. ins. per min. per 1 lb. of steam condensed per hour, a further alteration should be made in its construction.

$$D = \frac{0{\cdot}755\ (t + 460) \times (k + m) \times 1728}{P_2 \times 60} + n.$$

$$= \frac{21{\cdot}8\ (t + 460) \times (k + m)}{p_2} + n.$$

where D = Pump displacement, in cub. ins. per min. per 1 lb. of steam condensed per hour.
t = temperature of tail water in deg. F.
P_2 = Pressure of the air (*see above*).
k = a constant, for type of apparatus. *See* Table 1.
$m = W \times 0{\cdot}0001$ or $\dfrac{\text{lbs. of injection} \times 0{\cdot}0001}{\text{lbs. of steam}}$
$n = (W + 1) \times 0{\cdot}462$ = volume of tail-water
W = weight of injection in lbs. per 1 lb. of steam condenser per hour.

The curves given in Fig. 1 are plotted from this formula, tail water being taken at 10° below temperature proper to vacuum; injection water quantities are also given in the dotted curves. The values obtained from these curves are, of course, minimum values, and should be increased according to the designer's experience, and for the particular type of pump employed; for those unused to this type of work, the writer suggests an increase of 10 per cent. as being quite sufficient to meet all contingencies.

Barometric condensers, or low-level counter-current apparatus.—In this type the air is withdrawn at a point, either above or very little below the injection-water inlet, and is therefore removed at, or almost at, the temperature of the injection. The air pump deals with air only, and as this air is cooler, and therefore denser, the pump is necessarily smaller than the wet type of similar condensing capacity.

The formula giving injection water quantity is similar to that given previously, excepting that the temperature of the tail water is taken 5° below temperature proper to vacuum.

The temperature of the air is taken here as being 2° above that of the injection water, and this has been added to the absolute temperature value in the formula:

$$D = \frac{0{\cdot}755\ (t + 462) \times (k + m) \times 1728}{P_2 \times 60}$$

$$= \frac{21{\cdot}8\ (t + 462) \times (k + m)}{P_2}$$

where the symbols have the same meaning as in the previous formula, except t, which in this case is the temperature of the injection water.

The curves given in Fig. 2 are plotted from the above formula, and, as before, are of course minimum values. It will be noticed that a vacuum of 28 in. or over requires very large pump capacity, when the injection exceeds 70° F., and as this temperature is generally lower than the usual for tropical countries, it is very rare to find apparatus designed for such high vacua when intended for such localities.

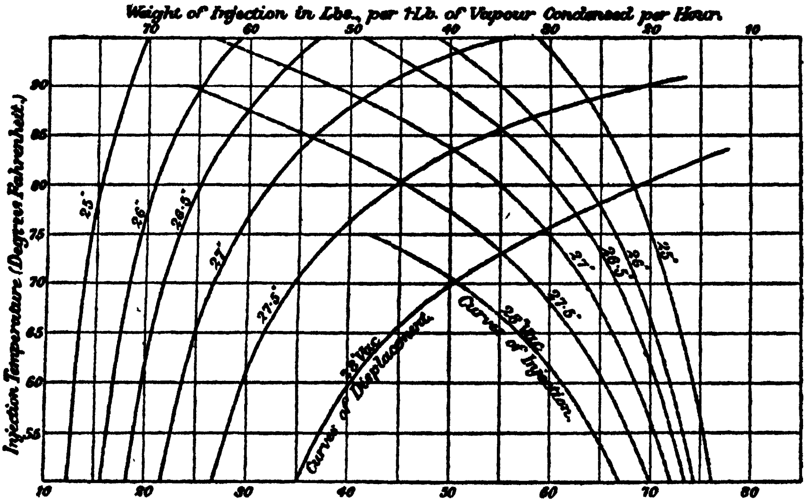
In actual practice, a small portion of the air is carried out in the tail water, but it is safer, as a rule, to neglect this quantity.

Surface condensers.—For this type of condenser very different conditions exist, the steam is condensed without coming into actual contact with the injection or circulating water, and the quantity of air to be dealt with is correspondingly reduced.

Most surface condensers are designed for counter flow, as this enables the circulating water to be used to the greatest advantage, and also allows the lowest possible temperature of the condensate being obtained.

There is a great deal in the design of surface condenser plant which depends upon special conditions, and as this is beyond the scope of the present article, the writer offers the curves in Fig. 3 as being only a guide, as it is almost impossible to give values which would suit all conditions.

Fig. 3. WET-AIR PUMPS. SURFACE-CONDENSERS.



The curves given are calculated on the assumption that the injection water is raised to a temperature 5° below that due to the vacuum, and that the condensate is cooled to 5° above the injection or circulating-water-inlet temperature.

$$V = \frac{21 \cdot 8\ (t + 460) \times k}{P_2} + n_2$$

where V = displacement of vacuum pump in cub. ins. per min. per 1 lb. of steam condensed per hour.
P_2 = pressure of the air (*see above*).
k = a constant, *see* Table 1.
n_2 = volume in cubic inches per min. of 1 lb. of condensed steam = 0·462.
t = injection temperature + 5°.

In the curves, k has been taken as 0·0048, which is the value for triple-effect evaporators, and the displacements given by these curves must be multiplied by the co-efficients given in Table 2, if any other grouping of apparatus is required.

TABLE I.—*Values of* "k" $= \frac{air}{steam}$ *in lbs. per hour.*

Type of apparatus.	"k"
Single effect	0·0044
Double effect	0·0046
Triple effect	0·0048
Quadruple effect	0·0059
Quintuple effect	0·0062

TABLE II.—*Co-efficients for correcting displacement given in curves, for groupings other than Triple effect.*

Type of Apparatus.	Co-efficient.
Single effect..	0·917
Double effect	0·958
Triple effect..	1·000
Quadruple effect	1·23
Quintuple effect	1·29

The word "air" used in many places throughout the text is intended to cover all incondensible gases.

The writer has not intended to give a thorough scientific reasoning, nor to make allowances for all the minute phenomena connected with this subject; such scientific, or, one should say, academic treatment is certainly desirable in dealing with research work, or in training students, but the error caused by the omission of these refinements in the formula are so small as to be negligible, and as the points for the curves were all obtained by slide-rule aid, such differences have no doubt been fully covered by the method of taking the next higher even figure.

The Paper Making Qualities of Hawaiian Bagasse.[1]

By ARTHUR D. LITTLE, Inc.

PREVIOUS ATTEMPTS TO UTILIZE BAGASSE FOR PAPER MAKING.

Previous experiments.—It is unfortunately true that many of the references to the utilization of bagasse for paper making which have appeared from time to time have very evidently been written by those who had no technical knowledge of the requirements which this raw material must meet. It is largely owing to such exaggerated and misleading statements that a certain amount of prejudice has been created against bagasse.

In 1856 THOMAS ROUTLEDGE, who first introduced esparto into England as a paper making material, carried out some experiments on bagasse and obtained results which indicated that the fibre from bagasse was quite similar to straw and esparto and was well adapted for paper making purposes. In 1878, CARL HOFFMAN supervised the preparation of several hundred tons of bagasse pulp in a mill in Maryland owned by the Philadelphia Public Ledger. In both cases, it is interesting to note that there appeared to be no question as to the quality of bagasse fibre, and the verdict of both men (whose reputations in the pulp and paper world were of the best) was that bagasse under suitable treatment would yield an excellent paper making fibre. The attempt to utilize bagasse commercially as made by HOFFMAN failed, it is understood, because of the difficulty in insuring a steady and sufficient supply of the raw material. Since that time, a number of attempts have been made to utilize bagasse, most of these ventures being carried out in the southern United States.

E. H. CUNNINGHAM & Co. attempted to make a cheap grade of paper from bagasse by boiling it with lime. The inferior quality of the product, together with the low market price which it commanded, contributed to the closing of the mill, although it was reported that failure was brought about by the heavy floods which devastated Galveston and a great deal of Southern Texas in 1900.

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[1] Extracted from the Report of the Experiment Station of the Hawaiian Sugar Planter's Association; Bulletin No. 46, Agricultural and Chemical Series, Honolulu, T. H., 1919.

In 1903, the United Railway & Trading Company with offices in New Orleans, endeavoured to manufacture a satisfactory grade of wrapping paper from bagasse. They experienced much trouble due to the hard, brittle character of the paper which they turned out, a result entirely to be expected from their practice of cooking the bagasse with lime. We understand that this company abandoned the idea of using bagasse, after demonstrating that a marketable grade of wrapping paper could not be made from it with the equipment available.

The United Fruit Co., in 1915, erected a small paper mill at Preston, Cuba, for the purpose of manufacturing wrapping paper from bagasse. It had a capacity of about 4 tons daily, and its operation was carried out under the direction and patents of Mr. Tennant Lee. The bagasse was cooked with caustic soda, and there was no effort to reclaim the alkali. The samples of paper which we have seen are of a very coarse grade, full of dirt, and apparently only intended for local consumption as a wrapping paper. The small size of the mill, increasing cost of chemicals, and the low grade product, all contributed to the failure of the project, so that the operation was discontinued after a few months. It should be understood in this connexion that this venture had nothing to do with the utilization of bagasse prepared by the Simmons process.

The Sugar Cane By-Products Co. first came into prominence in 1917, when it launched a widely advertised campaign inviting subscriptions to its stock. It claims to have a mill in the course of erection at New Iberia, La., to convert bagasse into a high grade pulp according to a process patented by Mark W. Marsden.[1] In their prospectus, the following statements appear, which to those having the barest conception of the cost of making pulp and paper are truly amazing.

"Our estimated cost is $9·50, including the raw material, overhead, and other expenses, to produce from a ton of bagasse: 550 lbs. of paper pulp, conservatively estimated to be worth 5 cents per lb., $27·50; 650 lbs. of raw cellulose, conservatively estimated to be worth 3 cents per lb., $19·50; 15 gallons of alcohol, conservatively estimated to be worth 35 cents per gallon, $5·25; 200 lbs. fertilizing material, conservatively estimated to be worth ½ cent per lb., $1·00; total $53·25. In other words, one ton of bagasse should produce finished products conservatively estimated to be worth $53·25, and the estimated cost of producing these products is $9·50, which will leave a net profit of $43·75 per ton. Our first mill will ultimately produce 300 tons per day."

In addition to the foregoing attempts to utilize bagasse for paper making, we understand that the New Orleans *Picayune* was printed for a short period a number of years ago on paper made from bagasse. We have no information available as to the origin of the paper used, nor do we know the outcome of the experiment from the publisher's point of view. It may also be mentioned that in 1900 an attempt to make paper from bagasse was carried out in the British West Indies. The mill was operated as a result of experiments carried out by Mr. Bert de Lamarre, and at least one issue of the Trinidad *Mirror* was printed on paper made by him. His process consisted in cooking the bagasse with a low percentage of caustic soda and at a low pressure. No attempt was made to bleach the pulp.

Several years ago Mr. Viggo Drewsen, of New York, carried out an extensive series of experiments on bagasse at the mills of S. D. Warren & Company, Cumberland Mills, Maine. As a result of these experiments, Drewsen was granted a number of patents,[2] one of which has to do largely with treatment of bagasse to remove the pith. It is to be noted that he cooked the bagasse with caustic soda, and then washed out the pith, following the same procedure which we followed on our experimental work. In the latter case, however, the pith was separated from the bagasse before cooking, which has the advantage of not wasting the alkali through its unavoidable action on the pith.

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[1] *I.S.J.*, 1916, 385; 1917, 238; 1918, 527. Also U.S. Patents, 1,251,261 and 1,269,476.

[2] U.S. Patents, 853,943 and 1,229,422.

Causes of failures.—In practically all the attempts which have been made to commercially develop bagasse as a paper-making material, excluding those ventures which have been manifestly stock selling propositions, failure has been brought about largely from a lack of comprehension of the characteristics of bagasse as a paper-making material, or an attempt to convert it into a grade of paper to which it inherently was ill adapted.

In the first instance, two factors which operate against bagasse are its large bulk and relatively low yield of fibre. For example, the yield of fibre from spruce by the sulphite process is about 51 per cent. of fibre and 1 cub. ft. of loosely packed dry spruce chips weighs about 10 lbs. Contrasted with this, the yield of fibre from bagasse is approximately 30 per cent. and the weight of 1 cub. ft. of bagasse containing about 20 per cent. moisture and loosely packed is 3 lbs. In other words, 1000 cub. ft. of digester capacity would yield per cook about 5100 lbs. of spruce fibre as against 900 lbs. in the case of bagasse.

The force of this objection is, however, much lessened if the pith is removed from the bagasse before it is cooked. A slightly better digester charge can be made, and the yield is increased from about 30 per cent. to 45 per cent. So far as we are aware, no large scale industrial attempt has been made to use bagasse in which the fibre has been separated from the pith.

As to the quality of paper made, we do not believe that the possibilities of bagasse lie in the field of wrapping and coarse papers. Such papers could at best compare with cheap straw papers. To make high grade paper, however, more elaborate equipment would be required, and to be successful a thorough knowledge would be necessary of the correct technical details for converting bagasse into paper.

GENERAL SURVEY OF THE QUESTION OF THE UTILIZATION OF HAWAIIAN BAGASSE FOR PAPER MAKING.

Object of investigation.—The present investigation, the results of which are embodied in the following report, was undertaken for the purpose of making a detailed study into the technical and economic conditions affecting the proposed use of Hawaiian bagasse as a paper-making material. That part of the investigation which concerns the technical problems involved has been accomplished with no undue difficulty, and the results obtained are strictly in line with the much more extended researches made a few years ago in connexion with Cuban bagasse. The economic problems involved in a proposed utilization of Hawaiian bagasse have been exceedingly difficult to handle. All the elements which enter into a pulp or paper proposition have been tremendously affected within the past few years and the extent to which the cost of labour, chemicals and equipment will revert to the pre-war level is a matter of pure conjecture. It is, therefore, quite necessary that the conclusions reached in connexion with the present problem be interpreted with proper regard to the generally admitted abnormal conditions now prevailing.

Samples submitted.—It was considered desirable to compare the bagasse from a few of the principal varieties of cane grown in the Islands; also, to determine, if possible, the effect on the paper making qualities of the bagasse of the mechanical treatment to which the cane had been subjected in the sugar mill. To this end, four samples of bagasse were submitted with the following descriptions. Lot No. 1 was from cane of the Yellow Caledonia variety. The milling machinery which prepared the bagasse did not include a Searby shredder. Lot No. 2 was from the Yellow Caledonia variety. The milling machinery which prepared the bagasse included a Searby shredder. Lot No. 3 was from the Hawaii 109 variety. This sample we understand was not shredded, but, coming from a 20-roller mill, was expected to be approximately as well disintegrated as Lot No. 2. Lot No. 4 was from cane of the Lahaina variety. The mill included a Searby shredder.

Influence of Variety of Cane.—The quantatitive results obtained in our small experimental paper mill runs were subject to considerably more variation than is usually the case. This was due to the necessity of first separating the pith from the fibrous portion of the bagasse. In carrying this operation out on a small scale the experimental error was rather great. However, in so far as we could determine, there is no appreciable difference between any of the three varieties of bagasse submitted, as to the quality of the pulp produced. Of the three, Yellow Caledonia appears to give the best yield of pulp. The Hawaii 109 variety gave a slightly lower average yield of bleached pulp than the Yellow Caledonia. Of the three different varieties, the Lahaina bagasse gave the lowest yield. The difference between Yellow Caledonia and Lahaina was quite striking.

Influence of Cane Preparation.—Considerable experimental work was carried out on Lots No. 1 and No. 2, consisting of Yellow Caledonia bagasse, not shredded, and shredded respectively. The difference to be expected here would be quantitative and a slightly lower yield of bleached pulp was found in the case of Lot No. 2 or shredded Yellow Caledonia bagasse. The lower yield is very probably due to the greater loss of fine fibre incidental to mechanical separation of the pith and fibre. Under other conditions, it is probable that there would be no decrease in yield produced by shredding. That is, we do not believe that the shredding operation inherently involves a lower pulp yield.

Pulp Making Methods.—To make a high grade pulp or paper from bagasse three well-known methods of cooking the bagasse are available, viz.:—the soda, sulphate, and sulphite processes. The sulphate and sulphite processes are most generally applied to coniferous or long fibred woods, while the soda process is usually employed with deciduous or short fibred woods. The term "sulphite pulp" therefore refers more particularly to the nature of the fibre than to the process. Likewise, in speaking of soda pulp, it is generally understood that a short fibred wood, such as poplar, has been used. At this place, it is only necessary to note that Hawaiian bagasse can be successfully reduced by either soda or sulphate process. The experimental differences as to yields and quality of pulp were found to be small, or at any rate proportional to the different cooking conditions employed There was nothing to indicate that either process compared to the other is pre-eminently adapted for cooking Hawaiian bagasse. The sulphate process is somewhat cheaper to operate because of the lower cost of chemicals; but the advantage in this respect is offset by the objection that the sulphate process is characterized by a most persistent and offensive odour which might be serious if the process were to be installed near a large community. In general the sulphate process will show slightly higher yields of pulp and in many cases the pulp obtained is somewhat easier to bleach. In the case of Hawaiian bagasse, our experimental results did not show this advantage of the sulphate process. However, if the pulp mill could be situated so that the odour would not constitute an objection, we believe the sulphate process better suited for cooking Hawaiian bagasse, otherwise the soda process would be employed. There is not a great deal to choose between the two processes from a standpoint of technical operation.

Yield of Pulp.—The yield of bleached pulp obtained from the various samples and different experiments varied considerably. Probably the greater part of the variation between different experiments in which the cooking conditions were identical was caused by irregularities in the mechanical operation of separating pith and fibre. However, we consider that the results obtained show that a yield of bleached pulp of approximately 30 per cent. can be expected from the bagasse of the Yellow Caledonia variety. This means that from 100 lbs. of air-dry bagasse, there would be obtained about 30 lbs. equivalent weight of air-dry bleached bagasse pulp. It should be emphasized that this figure is based upon the original bagasse, *i.e.*, with no separation of pith and fibre. As used in the pulp mill, the bagasse would have been mechanically treated to separate the pith and the latter would be available for fuel or other purposes. Regarding the other two varieties of bagasse Hawaii 109 showed a yield of about 26·7 per cent. bleached pulp, and Lahaina bagasse yielded but 22·3 per cent. under practically identical conditions of cooking.

It is interesting to compare the average yields of bleached pulp from Hawaiian bagasse with the yields of bleached pulp from Cuban bagasse. The latter when treated by Simmons process[1] was found to give approximately 38 per cent. of screened bleached pulp based on the dry, shredded, sifted bagasse. On the same basis Hawaiian bagasse yields very nearly 48 per cent of screened bleached pulp. There is no doubt but that the older growth of Hawaiian bagasse with consequent greater lignification contributes to a large part of this increased yield. On the other hand, the Hawaiian bagasse after treating experimentally to separate pith was cleaner than the Simmons fibre, which would in itself produce a higher yield.

Quality of Pulp.—In the case of all three varieties there was no perceptible difference in the quality of the fibre. Hawaiian bagasse fibre appears to have practically the same characteristics as the fibre from Cuban bagasse. In length it is shorter than so-called soda pulp, which is typical of the shortest bleached fibre in large scale use in the United States. If the bagasse pulp were to be marketed as such, it would have to compete against bleached soda pulp and we firmly believe that bagasse pulp has certain points of superiority compared to soda pulp. In strength, paper made from bagasse, soda, and sulphate fibres respectively, indicate that the bagasse occupies a position between soda and sulphite. In view of our investigation of Cuban bagasse, the results indicated that the fibre would make an excellent book paper, for which purpose soda pulp is commonly employed. The bagasse sheet has a tendency to be somewhat harder than in the case of soda, but this feature, which is not desirable in a book paper, can be satisfactorily met by the use of more loading in the sheet. In this field alone, if bagasse fibre were successfully introduced, the tonnage which could be reasonably disposed of would be far in excess of the output of any initial mill.

In the field of writing papers, bagasse pulp offers distinct possibilities. The fibre imparts a certain "feel" and character to the sheet which is very desirable. In strength, bagasse is somewhat weaker than sulphite pulp. With bagasse fibre alone, a bond paper can be made which has excellent qualities of "feel" and finish, but is rather deficient in strength.

In short, we are of the opinion that Hawaiian bagasse fibre possesses many characteristics which permit its being classed as a valuable paper-making fibre. Although capable of yielding a good sheet of paper in itself, bagasse pulp would undoubtedly be used as a mixing fibre with other longer fibred pulps and very probably would find its widest application in admixture with rag, sulphite, or soda fibres, for the production of book papers and cheaper grade writings. For wrappings and other papers in which strength is the principal consideration it would be of comparatively little value.

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[1] *I.S.J.*, 1916, 386; U.S. Patents, 1,153,934 and 1,155,741.

Cost of Raw Materials.—In the Hawaiian Islands bagasse cannot be considered as a waste product in the common sense of the word, but rather as a by-product having a distinct value. This value, which depends entirely on its utilization as a fuel, will naturally vary according to the cost of the fuel oil which it replaces. In a well balanced sugar mill, the output of bagasse practically covers the heat requirements of the mill, so that very little fuel has to be brought in from outside sources. In the case of a sugar mill, which is developing its power practically entirely from bagasse, any division of the bagasse supply from the boiler-house will require an equivalent amount of fuel oil to replace it, unless of course, other economies are effected which will tend to cause the bagasse output to be in excess of boiler-house requirements. In the present report, our estimates have been based on conditions prevailing in 1912, on account of the abnormal prices now prevailing. Accordingly, a value of $1·20 per ton has been placed on green bagasse carrying 45 per cent. water, this value, which is undoubtedly low for the present time, applying to the period mentioned. At this valuation the cost of raw material immediately places bagasse in a very favourable position compared to other sources of pulp and paper raw materials.

Preparation of Bagasse.—Bagasse as it comes from the mill is unsuited for pulp-making on account of the high content of non-fibrous cellular tissue or pith, which in itself has no paper-making value, and constitutes an impurity which must be removed. By shredding the bagasse as it comes from the sugar mill somewhat more finely and then sifting in a rotary screen, practically all the pith can be removed together with some of the finer fibre. In other words, it is necessary to carry the results obtained by shredding and milling somewhat further, so that a fairly clean preparation of pith and fibre can be obtained. It has been found perfectly possible to do this on Cuban bagasse at a very low cost and we have no doubt but that such an operation could be carried out on Hawaiian bagasse cheaply and efficiently.

Storage of Bagasse—One of the troublesome features in connexion with the use of Hawaiian bagasse for pulp and paper-making purposes lies in the fact that the bagasse would not be available throughout the year. Since it would be highly impossible to consider operating a pulp mill for less than about 300 days a year, some provision would have to be made for the "off" season. Either of two expedients suggests itself. In the first place, some other source of fibre might be employed. For example, bamboo has been shown to yield an excellent pulp which closely compares with bagasse. Although we understand no bamboo is available at present, the introduction and intensive growth of a sufficient quantity of bamboo to supplement the bagasse supply when the latter is not available might be considered.

Another and possibly more effective means of meeting this difficulty would be to store sufficient bagasse to carry the pulp mill when the sugar mill is not grinding. Undoubtedly the bagasse would have to be dried to prevent fermentation, but this operation would not be difficult, particularly if a gradual surplus of bagasse were built up during the whole of the grinding season. The most serious objection to bagasse storage consists in the space required. The sifted bagasse necessary to run a 30-ton pulp mill for 100 days would occupy approximately 1,200,000 cub. ft.

As another alternative, if a small capacity pulp and paper mill were considered most feasible, the pulp mill might be designed with a capacity large enough to provide the paper mill with pulp for that period of the year in which bagasse would not be available. In other words, the pulp mill would operate during the grinding season only, while the paper mill would operate 300 days a year. It should not be necessary to dry the pulp, since it could readily be stored in the wet condition. The storage capacity required would obviously be much smaller than that required for bagasse, so that this matter should present little difficulty. In the case of a 10-ton paper mill, roughly 1000 tons of bleached pulp would have to be accumulated during the grinding season, for running the paper mill during the off season, assuming the latter were to amount to 100 working days.

Size of Mill.—The size of the pulp and paper mill is impossible to define, but we have considered as alternative propositions either a 30-ton mill or a 10-ton mill. The capacity in either case is based on a 300-day year, and a daily output of 30 and 10 tons respectively. From the standpoint of financial return, the smaller mill is not attractive. On the other hand, the proposition of manufacturing and marketing bagasse paper successfully is a new one. There are certain features upon which the success of the whole enterprise depends and which are difficult to determine except on an operating basis. Pre-eminent among these is the problem of securing a steady supply of bagasse for a 300-day operation on a 30-ton or larger basis.

In view of this, a 10-ton mill might prove more attractive to those furnishing capital on account of the smaller investment, and the opportunity of gaining the necessary experience. Such a mill, however, must be regarded as a demonstration plant, and should be considered as the initial step in a subsequent and larger development.

Estimated Cost of Equipment.—It is altogether impossible to make any satisfactory estimates for the cost of a pulp and paper mill at the present time. Almost every item which would enter into the cost of the erection and equipment of a mill has increased by a considerable margin over pre-war prices. In 1912, we accumulated very full and accurate data as to the cost of equipment and operation of a 50-ton bagasse pulp and paper mill. After due consideration, we have decided to base our estimates on conditions prevailing at that time, rather than attempt to use prices and costs which are in almost every case admittedly abnormal.

The estimated cost of a 30-ton pulp and paper mill complete, with buildings and a suitable power plant would be approximately $550,000. For a 10-ton pulp and paper mill complete, with buildings and a power plant, the estimated cost would be $200,000. In the case of the 30-ton mill, approximately $50,000 would be required for working capital, and $25,000 in the case of the 10-ton mill. The total investment required would then be approximately $600,000 for the 30-ton and $225,000 for the 10-ton mill, all figures being based on pre-war conditions.

Operating Costs and Profit.—In estimating operating costs we have tried to make all figures conservative, and as in the case of the equipment estimates, all figures given apply to pre-war conditions. Even under these conditions a number of assumptions have necessarily been made. Without going into a detailed discussion of these figures at this place, mention will only be made of the percentage return which might be expected from either of the two alternative propositions.

Under the assumptions made, a pulp and paper mill with a daily capacity of 30 tons of paper would yield a net profit of 25·3 per cent. Under similar conditions, a 10-ton pulp and paper mill might be expected to show a return of 13·4 per cent. In both cases, the percentage return has been calculated after deducting interest at 6 per cent. on the total capital invested. From an economic standpoint, it is our opinion that a well-designed 30-ton pulp and paper mill would present an attractive commercial venture under normal conditions. Under the same conditions, a 10-ton pulp and paper mill will not offer especially attractive financial possibilities. However, if the latter were designed so as to provide opportunity for a large expansion, it might easily be converted into a better paying proposition at a later date. In any event, any decisive action should be deferred until trade and labóur have reached a more stable condition. It would then be well to have estimates and market conditions revised to date, and in the light of such revised data some definite and decisive course of action could be adoped.

Publications Received.

Pyrometry. Chas. R. Darling, F.I.C. Second Edition. (E. & F. N. Spon, Ltd., 57, Haymarket, London, S.W. 1.) 1920. Price: 10s. 6d.; postage, 1s.

High temperature measurement is a matter of importance in manufacturing operations, and modern sugar factories and refineries make use of some type or other of pyrometer, in order to control the operation of their bagasse furnaces, char kilns, etc. This book first appeared in 1911, and was founded on a course of lectures before the Society of Arts, London, and the attempt made by the author to collect information required by those making actual daily use of pyrometers has proved a successful one. In the present enlarged edition (containing 69 illustrations) parts have been revised in conformity with the latest practice, certain improvements having been developed during the war. As it now stands the book is an excellent practical treatise, and is written in the same lucid style as that in which those interested in physical subjects are accustomed to hear Mr. DARLING lecture.

Industrial Alcohol. By Robert N. Tweedy. (The Co-operative Reference Library, Plunkett House, Dublin, Ireland.) Price: 1s. net.

Mr. Tweedy's pamphlet is a popular discussion of the desirability of establishing an industrial alcohol industy in the United Kingdom, using potatoes as a raw material, most of which would be grown in Ireland. He advocates research work in various directions with the view to cheapening production, and concludes with the statement that "if something on these lines is not done we shall get our industrial alcohol, but it will come to us in tank ships from abroad under the heavy hand of the Oil Trust[1], and from the home distillation of imported molasses. . . . Our supplies of liquid fuel ought to be obtained within the limits of these islands if we are to hasten recovery from the financial effects of the war, and if we are to be provided with the means of resistance in the event of other wars."

Report of the Comptroller-General of Patents, Designs, and Trade Marks for the Year 1919. (H.M. Stationery Office, Imperial House, Kingsway, London, W.C. 2.) Price: 4d.

Inter alia it is stated that during 1919 there was a remarkable recovery in the work of the office, the number of applications and specifications filed during the year under review being the highest on record, namely 32,853 and 18,922 respectively.

Eradication as a Means of Control in Sugar Cane Mosaic or Yellow Stripe Disease. By F. S. Earle. Bulletin No. 22. (Insular Experiment Station, Department of Agriculture and Labour, Porto Rico.)

A considerable number of the more progressive planters in Porto Rico have followed the directions given by J. A. STEVENSON[2] for controlling the disease by a system of eradication. Uniformly favourable results have been obtained at moderate cost. This system of eradication consists in: (1) planting only healthy seed; and (2) eliminating all plants showing signs of disease when the cane is about a foot high, this inspection being repeated at intervals of 10 days until no more cases can be detected. Letters from planters who have carefully followed out the details given by the Experiment Station for putting the system into practice lead to the conclusion that the mosaic disease can be controlled in this way in all regions where a supply of healthy cane is still available. In addition to Kavangire (which is completely immune) other varieties that may be planted are as follows: Java 36; Java 234; so-called "Egyptian cane"; and G. C. 1313. These kinds take the disease freely, but they are stated to be so resistent to its effects that it does them no appreciable harm.

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[1] He says that the Industrial Alcohol Co. is controlled by the Standard Oil Trust. It is stated to have the largest distillery in the world situated on Chesapeake Bay, near Baltimore, Md., Cuban molasses being used.

[2] Circular No. 14; Insular Experiment Station, Porto Rico.

The Mosaic Disease of Sugar Cane and other Grasses. By E. W. Brandes. Bulletin No. 829. (U.S. Department of Agriculture, Washington, D.C., U.S.A.)

Contents of this Bulletin include: History and distribution of the disease; symptoms; susceptibility; nature of the disease; and control (by roguing, exclusion, eradication; and planting immune varieties).

Trade Notices.

Saccharimeters. (Adam Hilger, Ltd., 75a, Camden Rd., London, N.W. 1.) 1920.

Messrs. Hilger Ltd. have just issued a very readable booklet on saccharimeters in general and their special instruments in particular, in which they give an interesting account of the development of polarimeters from the earliest type of Biot, and discuss the French, the Ventzke, and the present international scales. It is to be noted that this firm accepts the data of Bates and Jackson, of the Bureau of Standards, Washington, for the establishment of the 100° point of the international scale, and that all Hilger instruments (unless instructions are given to the contrary) are thus standardized, instead of by means of the value obtained by Herzfeld and Schönrock. A special method has been devised for testing the "optical purity" of the quartz plates for making the wedges, and it is found that even if the plates are cut from *selected* quartz crystals only one-seventieth of the area is considered to be satisfactory for this purpose. Another matter worth noticing concerns the filter for monochromatizing the white light used. In place of the filter consisting of a 6 per cent. solution of potassium bichromate in a 15 mm. cell, which frequently requires attention owing to air bubbles cutting off the field, Messrs. Hilger have been successful in making an aniline dye filter of durable character that has an absorption curve closely following that of the other. This booklet, which is a very instructive one (and is obtainable on application), will be read with much interest by chemists.

The Manufacture of Alcohol from Molasses and Cane Juice. (J. Magné, Chemical Engineer, 36, Morgan Boulevard, New Orleans, La., U.S.A.)

Mr. Magné's pamphlet, which comprises a small treatise on alcohol production, should be read by all interested in this subject—one which is attracting considerable attention in certain quarters at the present time in connexion with projects for the manufacture of motor fuel. He describes his pure yeast apparatus, by means of which it is now possible to realize the great advantages of employing pure cultures in the distillery without the services of a competent and skilled operator. In using this apparatus, it is sufficient to seed it at the beginning of the campaign with the contents of a bottle of pure yeast culture in order to obtain the quantity necessary each day for use in the vats, thus ensuring a satisfactory fermentation with good yields throughout the entire manufacturing period. Many distilleries using ordinary yeast with or without the addition of antiseptics obtain yields from 50 to 75 per cent. of the theoretical quantity, but when pure culture yeast is used the amount may be raised to 85 to 95 per cent. References from distillers in different parts of the world show that the Magné apparatus makes it possible to realize the highest possible yields, and letters from these firms here reproduced bear evidence of its convenience and efficiency. Copies of this interesting pamphlet (which is well illustrated) are obtainable on application to Mr. Magné.

American Commerce Reports.[1]

SUGAR GROWING IN PERU.

The area officially reported as now producing sugar cane in Peru is almost 100,000 acres, but the actual area is slightly larger. According to official returns the various districts produced 253,176 tons of sugar in 1917, and unofficial figures placed the 1919 production at 300,000 tons. It is estimated that the 1920 crop will approximate 2,500,000 tons of cane, or 325,000 tons of sugar. This average per acre appears low, and may be accounted for by inefficient cultivation on many plantations and an inadequate water supply. Land with sufficient irrigation and proper cultivation should produce 50 to 60 tons of cane per acre. The sugar-producing area of Peru is divided among the several districts and departments as follows:—

	Acres.
Chicama, Department of La Libertad..	41,000
Lambayeque, Department of Lambayeque	15,000
Zaña, Department of Lambayeque	5,000
Santa Catalina, Department of Lima	8,000
Cañete, Department of Lima	6,000
Carabayo, Department of Lima	5,000
Nepeña, Department of Ancash	5,000
Other districts	15,000

Cost of land, irrigation, and labour.—The amount of land capable of irrigation which remains unused is small, one well-informed sugar grower estimating the land subject to development at 40,000 acres. The cost of this improved land varies from $5 to $25 per acre, depending on the nature of the irrigation necessary.

In a gravity system of irrigation, the opening of a take-out canal and the construction of its ramifications represent a maximum cost of $70 to $80 per acre, and an annual maximum maintenance of $8 or $9 per acre. In a pumping system, the installation expenses would probably vary from the above only in the cost of a pump and an engine. The cost of pumping (from wells), maintenance and service ranges from $25 to $27·50 per acre annually. A large number of internal-combustion fuel-oil engines are being brought into Peru for this purpose. In districts where the rivers flow for considerable distance with little fall, the pumping is done from the river, the lift varying from 5 to 8 feet.

Rainfall is disregarded in the coastal plain and valleys, although the heavy mists and dews tend to lessen the amount of water needed from July to November. To calculate canal or pumping volume, 400 gallons per hour per acre throughout the year are taken. This means a maximum of 127 ins. per year, which could very well be reduced through greater care in operation. As compared with the rainfall in Cuba or Louisiana, the amount of irrigation required in Peru seems excessive; but in Peru the cane is produced and may be cut during the entire year, the yield on good land, well cultivated, being twice as much as in Cuba, and the percentage of sugar content is higher in the Peruvian cane. The volume of water used is somewhat lower in Peru than in Hawaii and the sugar content is slightly higher.

Many planters complain of the scarcity of labour, yet in comparison with other sugar-producing regions it is cheap and plentiful. Unskilled labourers not on piecework receive from 65 to 70 cents U.S. currency per day. Skilled labour is paid on a piecework basis, so far as possible. The cost of labour has advanced 40 per cent during the past two years, but efforts are being made by the planters to prevent any further increase.

Sugar content, cost of mill installation, taxes.—The staple raw sugar polarizes at 96° or 97°. With modern grinding and extracting machinery, Peruvian cane will yield from 14 to 16 per cent. of its weight in sugar. However, most of the mills in operation do not have much equipment, and the average for the country would probably not exceed 12 per cent. On the tally sheets of a typical mill, that of the Pardo syndicate at Santa Inez, the percentage ran steadily through nine months of grinding at 11·50 to 11·75 per cent. for the season before last, and at 12·20 to 12·40 per cent. for the last season. Peru presents nearly ideal conditions for grinding, and the mills could be worked every day. It is necessary to work them only six or eight months of the year, however, to grind the cane available. Thus they could easily take care of additional planting.

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[1] Culled from "Commerce Reports," published by the Department of Commerce, Washington. In many cases these are abbreviated here.

Experience has shown that at current prices a modern mill may be installed at the rate of $1000 per ton of cane ground per day. Thus a comparatively small mill grinding 800 tons per day would cost probably $800,000. In larger plants the ratio would be smaller. With modern machinery, a sugar content of 15 per cent. should be realized, or a daily production of 120 tons of sugar from 800 tons of cane. Assuming a sufficient planting of cane, and 300 working days to the year, such a mill would produce 36,000 tons of sugar annually.

Formerly, nearly all of the sugar exported went to Great Britain, and consequently all fiscal calculations relating to sugar are in terms of English money. In levying the tax a cost of production was assumed of 8s. per Spanish quintal of 101·4 lbs. ($1·92 per 100 lbs.), which is untaxed for export. While the law has not been changed, in present practice an accommodation is allowed, and 11s. 6d. per quintal ($2·76 per 100 lbs.) is assumed as the cost. An export tax of 10 per cent. is collected on the difference between that sum and the current market price. Just now 50s. per quintal is being assumed as the market price, although from 58s. to 60s. is being received. The present nominal export tax is 4s 2d. per quintal (about $1 per 100 lbs.), which may be raised or lowered as the market changes. No other tax is levied. Figures from reliable sources indicate that sugar may be delivered f.o.b. ship at 14s. to 15s. per quintal.

Principal producing countries and markets, future improvements.—The two plantations belonging to the Pardo syndicate, Tumán and Santa Inez, located near Eten, have together about 3500 acres. They are capably managed and produce nearly 20,000 tons of sugar per annum. The mills, however, are not modern.

The Tambo Real plantation, belonging to Barber, Vargas & Co., has about 4000 acres planted and an output of some 20,000 tons per year. There is enough unused irrigable land in this property to double the plantation.

The question of a market is the least of the sugar producer's troubles. Chile, which formerly received 90,000 tons annually, is now offering the best price and is taking increasing quantities. The United States and Europe receive nearly all of the remainder. The law requires an allotment from each mill for the benefit of the local market. This consumption is now slightly more than 40,000 tons per year. Retailers may sell at any price they wish, but the Government maintains agencies where the best white grade is sold at 36 centavos per kilo (about 8 cents. per lb), this price being fixed by decree. The mills which do not make white sugar have to make arrangements with other mills to supply their quotas.

A well-known Peruvian sugar producer has stated that the present output of the plantations could be doubled without additional planting by the use of modern machinery and methods and the introduction of improved efficiency. The average Peruvian planter is somewhat averse to changes and improvements. He is doing very well with his present methods and machinery, and he does not understand why he should take the trouble to do anything more.—[Trade Commissioner's Report, May, 1920].

GUATEMALA.

The sugar production of Guatemala for the year 1917-18 reached a total of 300,000 quintals, valued at $4 gold per quintal (1 quintal = 101·4 lbs.), delivered at the railway station. The export of sugar is not permitted, except under special permit from the Government. The scarcity and high price of sugar in Mexico during the war led to an enormous demand for Guatemalan sugar, and under special concessions granted by the Guatemalan Government nearly 150,000 quintals, or one-half the domestic production, were exported to Mexico, this total including a few shipments to British Honduras and Honduras. Only the best grades of sugar were exported. After the exports above detailed the Government refused all further requests for exports.

for it to compete effectually with Java. Freight rates, however, are to some extent in Formosa's favour, as it is much nearer the chief oriental markets for sugar than is Java.

The general prosperity of the sugar industry in Formosa is shown by the fact that the greater part if not all of the principal sugar companies are contemplating substantial increases in capital during the present year. This would seem to indicate, to some extent, plans for the future expansion of production equipment which should give opportunities for the sale of agricultural, milling, and refining machinery.

Brevities.

A committee, appointed by the Institute of Chemistry, have prepared a scheme for the testing of laboratory glassware and porcelain, which is recommended to the notice of manufacturers and users. Specifications of tests are described in respect of stability under pressure, solubility in water, behaviour towards hydrochloric acid and sodium hydroxide, resistance to sudden cooling at various ranges of temperature, freedom from arsenic and antimony, and internal stresses.[1]

A paper was recently read before the Royal Society of Arts, London, on the commercial application of electrical osmosis, by J. S. HIGHFIELD, W. R. ORMANDY, and D. NORTHALL-LAURIE.[2] An apparatus has been devised[3] for the coagulation of colloid solutions by subjecting them to an electric field by means of immersed electrodes, which has proved successful in the purification of clay. Attempts are being made to apply this principle to the treatment of sugar products.

The Customs duties on sugar entering Belgium are now as follows:—Refined sugars, juice and raw sugars, beet and cane, 20 frs. per 100 kg.; syrups and molasses not exceeding 50 per cent. sucrose, 10 frs. per 100 kgs.; exceeding 50 per cent. sucrose, 15 frs. Over and above the duty of 20 frs. per 100 kg. above-mentioned, a surtax of 5·50 frs. is levied on raw beet and cane sugars, and on refined sugars. The importation, manufacture, detention, and sale of saccharin and similar products, as well as products containing saccharin or similar substances, is prohibited.

A few mills in Cuba have established small capacity refineries, this production going into the local market; and the Cuban-American Sugar Co.'s plant at Cárdenas is still in continuous operation, while a 3000-barrel house is being built in connexion with the Central Limones, by Sr. LEZAMA, the owner. Recognizing that Cuba must seek other markets than the United States for a large proportion of its output, Sr. ANIBAL MESA recently put before the Association of Hacendados and Colonos a scheme for raising a considerable sum ($10,000,000 is mentioned) for the purpose of building, at favourable coast points, three up-to-date char refineries. It is stated[4] that favourable consideration is being given to this proposition.

At the Annual Meeting of the Society of Chemical Industry, held in July, at Newcastle-on-Tyne,[5] papers were read before the Chemical Engineering Group, by Mr. E. HATSCHEK, on "The Principles of Technical Filtration"; by Dr. W. R. ORMANDY, on "The Filtration of Colloids" (dealing with the osmose process applied to clays); Mr. E. A. ALLIOTT, on "Recessed Plate and Plate-and-Frame Types of Filter-presses"; by R. A. STURGEON, on his "Self-discharging Centrifuge"; and by S. H. MENZIES, on "The Sharples Super-Centrifuge." In the case of the latter machine, diameter is sacrificed to rate of revolution, and speeds of 15,000 to 40,000 r.p.m. are obtainable. Research work is in hand in connexion with the application of this invention to the clarification of sugar juices. It has already given good results in the separation of press mud (a mixture of protein matter and fatty acids) from glucose liquor, as well as for the dehydration of oily emulsions.

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[1] *Journal of the Institute of Chemistry*, 1920, Part III., 202-214.

[2] *Journal of the Royal Society of Arts*, 1920, **68**, No. 3527, 514-523.

[3] Particulars of which are obtainable from the Osmosis Co., Ltd., of London, operating the patents of the Elektro-Osmose Akt.-Ges., e.g. 144,727 and 146,453 (not yet published).

[4] *The Cuba Review*, 1920, **18**, No. 7, 32.

[5] *Chemical Trade Journal*, 1920, **67**, No. 1730, 77-81.

Review of Current Technical Literature.[1]

Use of Molasses as Fuel, and Preparation of Potash from the Ash Obtained.

G. E. G. von Stietz. Archief voor de Suikerindustrie in Nederlandsch-Indië, 1920, 28, No. 15, 519-533.

When molasses is burnt by mixing it with the bagasse on its way to the furnace, the disadvantage is that a troublesome slag is formed on the fire-bars, so that this procedure results in inconvenience in stoking and in loss of potash. In fact, it is not possible to burn molasses like most other fuels, because it gasifies with difficulty. Attempts have been made to dry-distil it, and burn the gas and coke obtained separately; but the great drawback in this method is the foaming of the product and the large volume of the resulting carbonaceous mass. Very large retorts are therefore necessitated. A special oven has, however, been invented by the author[2] in which the molasses entering is automatically pre-heated and carbonized by the burning gases of the coke, these gases being in turn heated by the glowing ashes. In this apparatus, it is possible so to regulate the combustion that coke or only ash is obtained. The ash obtained on completely burning such coke can be treated for the recovery of the potash, and some experiments have been carried out in this direction.

If the ash is leached out with a large amount of water so as to give a liquor of 10° Bé., the salt obtained on the evaporation of this extract will have the following composition: potassium carbonate, 70-75; potassium sulphate, 15-20; potassium chloride, 3-7; potassium silicate, 1-3; and matter insoluble in water, 1 per cent. If on the other hand, less water is used, say enough to give a liquor of 40° Bé., the extract is purer, and contains about 90 per cent. of potassium carbonate, and less than 1 per cent. of the sulphate.

Alternatively, and preferably, the ash may be extracted with an excess of water, and fractionally crystallized. Thus if an extract of 10° Bé. be evaporated to a liquor of 45° Bé. nearly all the potassium sulphate will crystallize out, and the separation may be rendered almost complete by conducting the hot liquor containing the crystals over cooling tables until a temperature of 85° F. (30° C.) is reached. Lastly, the mother-liquor having a purity of about 95 per cent. potassium carbonate is evaporated to dryness, and calcined in order to eliminate the organic matter, and thus obtain a white or almost white product. Potassium chloride and silicate will be the principal impurities in this salt, but their separation is hardly practicable in the sugar factory. When 1000 tons of cane are ground per day, about 30 tons of molasses may be produced; and in the case of every 100 tons of molasses one may obtain about 4·6 per cent. of potassium carbonate of 90 per cent. purity, and 2·0 per cent. of potassium sulphate of 100 per cent. purity. All the lime and magnesia remain in the insoluble ash, and part of the potassium silicate.

Ammoniacal Frothing of After-Product Massecuites.

Karl Urban. Zeitschrift fur Zuckerindustrie der Cechoslovakischen Republik, 1919, 44, No. 4, 21-24.

During the 1918-19 campaign the after-product massecuite of the Pecek factory was observed to froth in an unusual manner. It had been boiled to 92° Brix, and dropped into coolers at 85° to 90°C. forming a dark-brown mass free from bubbles. After 24 hours, however, a change was observed in the appearance of the strike. Its colour became light-brown, and it began to froth, the volume of the contents of the apparatus increasing by 5 to 7 per cent. A distinct ammoniacal odour was apparent, and moistened neutral litmus paper when introduced into the cooler turned blue. Frothing lasted 48 hours, ceasing when the temperature had fallen to 70° to 75° C. Chemical examination of the products behaving in this manner showed a rather large carbon dioxide content, greater than that of the original massecuite, but invert sugar was present only in small amount, while the total nitrogen content was strikingly low. Lafar[3] has suggested that in the frothy fermentation of low product massecuite the reaction between invert sugar and amino-acids, pointed out by **Maillard**,[1] occurs, carbon dioxide being eliminated and humic acid substances formed. **Andrlik**[2] has shown that during the concentration of syrups containing ammonium salts of amino-acids, NH_3 is evolved, and the alkalinity is decreased. This case of ammoniacal frothing, it is believed by the author, may have been due to the simultaneous occurrence of both these reactions.

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[1] This Review is copyright, and no part of it may be reproduced without permission.—(Editor, *I.S.J.*)

[2] A Patent has been applied for.

[3] *I.S.J.*, 1914, 184.

UTILIZATION OF PULP PRESS WASTE WATER IN THE BEET SUGAR FACTORY. (1) G. Duret. *Journal des Fabricants de Sucre, 1919, 60, No. 28, December 31st.* (2) H. Claassen. *Centralblatt für die Zuckerindustrie, 1920, 28, No. 18, 372-373.*

(1) About 50 litres of waste water (containing about 12 grms. of dry substance per litre in solution) are obtained per 100 kg. of roots from the presses which are used to reduce the moisture content of the exhausted slices from the diffusion battery. Instead of distributing this waste water over the land, or fermenting it, M. **Duret** proposes that it should be evaporated to a syrup of about 40°Bé , and mixed with the dry pulp or other suitable fodder, so as to increase its nutrient value. According to him, this concentration may be effected without using any extra coal. He explains that normally in the beet sugar factory in France it it necessary to use about 25 kg. of live steam per 100 kg. of roots, the exhaust available being insufficient alone for the working of the evaporators. This live steam comes from the boilers at 6 to 12 kg. pressure, and is expanded without useful effect to 2 or 3 kg. before going into the pre-evaporator. He therefore proposes that a double effect should be installed between the boilers and the factory evaporator to deal with these waste waters, and that it should have a heating surface of 1 sq. m. per 100 kg. of roots for the elimination of the 44 litres of water from the 50 litres of waste waters. Live steam at about 6 atmos. would be used (the temperature in the first body not exceeding 150°C.), and the vapour from the second effect would pass to the first effect of the ordinary juice evaporator of the factory. About 10 litres of this syrup, containing 6 kg. of dry substance, would be obtained per ton of roots, and it would contain 2·5 kg. of sugar, 0·8 kg. of proteins, 2·2 of other organic substances, and 0·5 kg. of ash. Its value is said to be 2·90 fr. per 1000 kg. of roots, while the patent royalties and maintenance charges of the additional plant would be about 0·90 fr., leaving a net profit of 2·0 fr. In the case of a *usine* slicing 500 tons per 24 hours, a double effect apparatus of 115 sq. m. would cost 200 fr. per sq m., i.e., 46,000 francs, or 60,000 including erection; but this would soon be wiped off, the gain being 2·0 fr. per ton, giving 500 × 2 = 1000 fr. per day, or 70,000 fr. in 70 days.

(2) However, Dr. **Claassen** points out that it would hardly be possible to realize the idea of concentrating these waste waters without cost under such conditions, even assuming no loss of heat in the additional apparatus installed between the boilers and the ordinary evaporating plant. One important point was overlooked, namely, the heating of the liquid from about 30 to 150°C., for which about 24 kg. of steam per 100 kg. of the press water would be required, or 8 to 10 kg. if it was preliminarily heated in two heaters fed from the first and second bodies respectively. Calculated on 100 kg. of roots at least 4 or 5 kg. of steam would be required for this heating, and (without taking into account other losses) the coal consumption would thus be increased by at least 1 per cent., costing, say, 0·5 fr. per ton of roots sliced, leaving 1·5 fr. as the net profit. Another point of disagreement is the value of the syrup, which at present prices would be nearer 18 frs. (about half the figure assumed). Moreover, practical difficulties in concentrating these waters would arise, such as the coating of the heating surfaces, and strong frothing. If one is to go to the expense of installing two extra evaporator bodies and two heaters with a large surface, it would probably be better (so Dr. **Claassen** suggested) first to clarify the waters by liming, carbonatating, and filtering, and then evaporate at a somewhat lower temperature to the density of thick-juice, obtaining a product of about 85° purity, which might be worked up with the syrup run-offs.

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[1] *Comptes rendus*, 1911, **153**, 1078.

[2] *Zeitsch. Zuckerind. Böhm.*, 1902-3, 437.

Review of Current Technical Literature.

USE OF MOLASSES AS MANURE IN MAURITIUS. *P. de Sornay. Bulletin de l' Association des Chimistes de Sucrerie de France, 1919, 37, No. 6, 223.*

Most satisfactory results have been obtained in Mauritius [1] when employing molasses as manure, these being such as to demonstrate that this is one of the best methods of utilizing this by-product. At times the results have been surprising, and some fields in which the cane was doing rather badly have been seen to give good yields after undergoing this treatment. Young cane acquires vigour, and the application is recommended as a means of furthering the growth of tardy crops, which (it is said) then catch up and even surpass those which have not thus been treated.

This effect is more marked than that which would be due simply to the potash and nitrogen present in the molasses. It was thought that it might be traced to fermentation occurring in the soil, having as a result the modification of the solubility of the constituents, so as to facilitate their assimilation. Experiments were made for the purpose of testing this theory, but the figures obtained gave no definite conclusion one way or the other. Another suggestion is that the potash may react with the "humophosphates" of the soil, rendering them more soluble, and in this way assisting growth. Discussing the contradictory reports from different countries on the value of molasses as manure,[2] it is thought that insufficient account has been taken of the varied conditions of the different soils and of vegetation. In regard to the results in British Guiana, it is to be noted that the molasses in that colony contains only 0·2 per cent of potash whereas that of Mauritius has 2·0 to 2·5 per cent., so that it would seem right to conclude that under the conditions of growth in that colony the cane requires little of this constituent. One of the best methods of applying the molasses is to place 0·5 to 1·0 litre in each cane-hole about 15 days before planting with or without the addition of further manure.

CRYSTALLIZATION OF SUGAR FROM ITS AQUEOUS SOLUTION. *H. C. Prinsen Geerligs. La. Planter, 1920, 64, No. 2, 30- 31.*

It has been noticed by certain observers that the crystallization of sucrose from its aqueous solution may be accelerated or retarded in a manner which hitherto has remained unexplained. One knows that such an influence may be due to the presence of non-sugars; while it is a recognized fact that in boiling cane syrups the formation of grain proceeds more smoothly than in the case of beet syrups, which difference may perhaps be attributed, either to the nature of the impurities, or to the reaction of the liquor, acid or alkaline respectively. There are, however, cases in which under apparently identical conditions a pure solution of sucrose may crystallize rapidly and at other times quite slowly. Dr. GEERLIGS himself noticed when carrying out his classical experiments on the formation of molasses that sucrose crystallized more rapidly when the solution had previously been heated to a relatively low temperature during a short time than when the liquid had been kept at a higher temperature for a longer period, while VAN DER LINDEN [3] has observed that a molasses which on cooling readily gave a crop of crystals failed to do so when the grain was re-dissolved and the liquid cooled in exactly the same way as before.

P. J. H. VAN GINNEKEN [4] recently published a highly interesting article dealing with this unexplained phenomenon. His method of operating ensured the use of solutions of a constant composition and degree of supersaturation, which were maintained at a constant temperature with an equal intensity of movement during crystallization. He found that the optimum concentration for grain formation is 83·5 to 84·5 per cent. at 80° C. (thus confirming Claassen's values); and he further observed that the time necessary for the formation of the first crystal is much greater than that required for the appearance of subsequent ones, temperature and concentration being kept the same. He found also that under 80 per cent. the tendency to form new crystals (rather than to grow on those already present) is so small as to be negligible. At 81 per cent. it is greater, but it is not practicable to keep the concentration as low as this when boiling, so that in sugar-houses the possibility of the formation of false grain under such conditions is difficult to preclude.

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[1] *I.S.J.*, 1911, 153; 1913, 427. [2] *I.S.J.*, 1911, 109-110; 1913, 373. [3] *Archief*, 1919, 1517.

[4] *Chemisch Weekblad*, 1919, 16, No. 38, 1210-1228.

In order to explain why the first crystal forms so much more slowly than those appearing later, VAN GINNEKEN suggests two possibilities, namely: (1) the auto-catalytic effect of the already present crystals on the molecules of sucrose in their vicinity; and (2) the formation of large complexes of sucrose molecules which are driven apart by heating, but on cooling gradually condense until they combine to crystals, at which point others have approached the same condition and consolidate very soon after. VAN GINNEKEN was able to confirm the observation that the previous heating of the solution retards subsequent crystallization. He heated solutions to 130° C., and others to 110° C., and proved that in the first case the time elapsing before the formation of the first crystal was greater than in the case of the lower temperature, though no decomposition of sucrose had occurred. Another striking observation was that if a solution of sucrose were crystallized and redissolved repeatedly the time taken for the appearance of the first crystal became longer after each operation, re-solution being likewise slower. Other experiments seemed to show that the previous history of the sugar is of some importance in regard to its crystallizing properties. Thus it was found that a pure sugar obtained by precipitating a concentrated aqueous solution of refined sugar with alcohol, and washing with alcohol and ether, crystallizes more slowly than the original refined sugar used (the small amount of impurities present in this refined sugar being proved to be without influence). It would therefore almost seem that the sucrose is precipitated by the alcohol in a configuration deviating somewhat from that in which it crystallizes from its aqueous solution. This possible explanation appears to find some support in the fact that the sucrose precipitated by alcohol after being kept in a bottle for a few months once more becomes normal in respect of its solubility. Van Ginneken's very interesting observations may have an important bearing on the proper operation of the vacuum pan; and it is hoped that the experiments he has commenced may be continued with the object of ascertaining more fully the factors controlling crystallization.

MANUFACTURE OF CANE AND SORGHUM TABLE SYRUP BY THE "NORIT" PROCESS, [AND THE COST OF REGENERATING "NORIT"]. *J. Sauer. La. Planter, 1920, 66, No. 14, 221-222.*

Table syrups are judged in the market by their body, colour, and flavour. Those commanding the highest price have a density of 37-39° Bé. (68-72° Brix), are light in colour (e.g., straw yellow), clear and brilliant, and possess the cane flavour with a slight caramel taste. In the method of manufacture generally followed in America, the juice coming from the mill is sulphured, limed, and heated, after which it is subsided, and evaporated. A formation of colour, it is stated, always occurs when lime is used, though this is minimized to some extent by the bleaching action of the sulphurous acid, an action which may not be permanent.

Better results are obtained by a process of clarification using "Norit." The strained mill juice is mixed with kieselguhr in a tank provided with steam coils and a stirring device (using 9-10 lbs. of the infusorial earth per ton of cane), and a small amount of lime added, only enough to partly neutralize the natural acidity. This mixture is boiled in the mixing tank, or passed through heaters, after which it is pumped through a plate-and-frame or other type of filter. Concentration to 30° Bé. (54° Brix) follows, and then the syrup is treated in suitable mixing tanks with "Norit" (adding about 5 per cent. on the solids present). On being heated to 180° F. (82° C.), it is sent through a filter-press, and subsequently through a bag filter[1] or some type of gravity filter, being finally transferred to the evaporators. Advantages of this procedure are that the removal of colour is permanent, not temporary; that the colour of the finished product can be controlled; that perfect clarification is effected, albumenoids being removed, and the resulting syrup rendered brilliantly clear; that the syrup is sterilized, the micro-organisms and their spores being adsorbed by the carbon; that there is an entire absence of taste from the use of chemicals; and lastly, that the time the juice is in process is shortened, long settlings for example being no longer necessary.

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[1] It is said to have been found that the juice from 1000 tons of cane per day can be filtered through one filter containing only nine bags, 6 ft. long and 2½ ft. circumference, after having been treated with "Norit."

Regarding the cost of this treatment, it is assumed that 25 gallons of syrup are obtained from one ton of cane. Kieselguhr costs about \$35 per ton (carload lots), and using 9 lbs. this will be 0·63 per cent. per gallon of syrup. Five lbs. of "Norit" are added per 100 of solids; but this may be used over again 100 times, making the amount 0·0365 lb., equal to 0·0042 lb. per gallon of syrup of 73 per cent. solids. "Norit" at present is \$500 per ton (of 2204 lbs.) New York, or 25 cents per lb. factory Louisiana, corresponding to 0·10 cent per gallon of finished syrup; but the cost of the revivification must be taken into account. In this operation 600 lbs. of hydrochloric acid (30 per cent. commercial), 500 lbs. of caustic soda, and about 400 lbs. of coke, and the labour of two men is required per ton of the carbon. Taking the cost of these items to be 2 cents per lb.; 3½ cents per lb.; \$10 per ton; \$5 per day respectively, regenerating 1 ton costs \$41·50. Calculated per gallon of syrup, this is 0·0085 cent for each regeneration, or 0·84 cent for 99. Recapitulating, the cost of treating syrup by this process per gallon is about 1·57 cent (kieselguhr, 0·63; "Norit," 0 10; and regeneration, 0·84 cent), other labour charges, fuel, barrels, over-head, etc., to be added so as to compute the total cost of production. This may work out at a higher figure than when sulphur and lime method is used, but a superior product is obtained by the use of "Norit," while the losses of sugar in process are less.

CHEMICAL CONTROL RESULTS OBTAINED IN HAWAII FOR THE 1919 SEASON. *E. T. Westley.*

Sugar Central and Planters' News, 1920, 1, No. 9, 1- 4.

A higher average extraction was obtained during 1919 than ever before, and a lower milling loss. One factory recorded an extraction for the entire season of 99·05, "which is getting pretty close to the limit." Another factory reports an average extraction of 98·99, seven factories finished the season with an average extraction of over 98 00, and 60 per cent. of the factories reported over 97·00 extractions; while one equipped with a 2-roller crusher and 9-roller mill reported an average of 97·96 extraction for the season. To make this good work possible, equipment has to be of the very best, the cane must be of a good quality, and the control must be very close. Each set of rollers must do its share, sufficient dilution must be applied at the proper places, the Messchaert juice grooves must be kept open, the feed must be even and the hydraulic pressure sufficient. The low rate of grinding employed in Hawaii is a large factor in favour of high extraction, but slow grinding cannot be employed in countries where the grinding season is limited, without having extra large milling plants. In Hawaii the crushing season lasts from eight to ten months. It is not always the mill that grinds the most cane per hour that does the most work. The percentage of fibre contained in the cane should be taken into consideration. If a mill grinds 50 tons of cane with a fibre content of 10 per cent. per hour, it will have ground five tons of fibre per hour. If another mill of the same size grinds 40 tons of cane containing 12 5 per cent of fibre per hour, this mill will also have ground five tons of fibre per hour. After all, it is the fibre that is ground and not the juice; and in order to compare the amount of work done by the mill, the tons of fibre per hour would be a better figure than the tons of cane per hour.

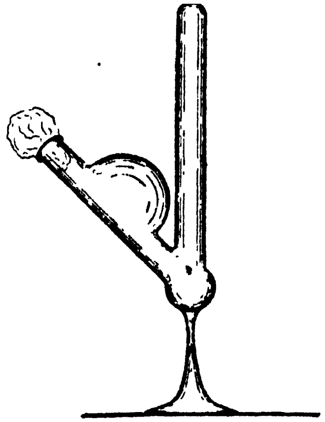
Next, taking the press work, we find that the sucrose lost in the mud has been reduced, although the quantity of mud has increased, due to the finer condition of the bagasse particles, some of which find their way into the boiling house in the mixed juice. It has become generally recognized in Hawaii that in order to do good press work, the mud juice must be alkaline and at the boiling point before going to the already heated presses; the presses should not be filled at a pressure above 20 lbs.; and the filling time should be as short as possible. The loss of sucrose in the molasses is steadily being reduced in Hawaii. This has been brought about by boiling the last massecuite very stiff (around 98° Brix) and on an even grain. The crystallizer massecuite runs between 55-60 apparent purity. The undetermined losses are also being reduced from year to year, but they are still rather high as they far exceed the loss in the mud. The average total losses for the Hawaiian factories have been reduced about 27 per cent. in the last 10 years; and this has been accomplished in spite of a steady decrease in the purity of the juices, which would in itself tend to increase the losses.

In Hawaii a standard has been set for factory efficiency. A factory getting 100 per cent. extraction, reducing the waste molasses to 30° gravity purity, and having no other losses, would be considered 100 per cent. efficient. The best so far obtained for one season in a factory is 96·71 per cent. efficiency, while last season (1919) about 85 per cent. of the factories were over 90 per cent.

One of the biggest factors in getting these results has been the spirit of co-operation which exists among the factory men. Every factory has the opportunity of benefitting by another's experience. Through united efforts, methods of manufacture are steadily being improved, new methods are employed, and old ones discarded. Although the results obtained in Hawaii cannot be duplicated in the Philippine Islands at once, the writer sees no reason why in time they should not be equalled; and in order to do this, the following conditions must be brought about. First, the cane sent to the mill must be fresh and the juice from same of a reasonably high purity, say, first expressed juice, of about 86° purity; second, the capacities of the various units in the factories must be adequate and well balanced; third, the factory crew must be well trained; and fourth, a strict chemical control must be kept on all the work in the factory.

MODIFIED FORM OF THE SMITH FERMENTATION TUBE. *Aubrey V. Fuller. Journal of Industrial and Engineering Chemistry, 1920, 12, No. 6, 595.*

It is frequently the case, especially in dealing with commercial problems, that the analyst desires early information as to the presence of organisms capable of causing the active fermentation of sugars. To this end, it is the practice to inoculate a fermentation tube, of either the Smith or Durham type, with a portion of the sample under examination, incubate and await developments. While, of course, this method yields satisfactory results when proper precautions regarding inoculation and incubation are observed, it is believed that for rapidity and certainty the modified construction of the tube pictured here offers certain advantages over the forms commonly used.



The bulb, instead of being symmetrical, is made trough-shaped on its under side in order to facilitate the falling of the growth to the lowermost portion of the gas tube proper, with the result that as the gas is liberated it rises vertically and is trapped without an occurrence of appreciable loss through the bulb, as is the case when the Smith tube is used. A very small quantity of fairly course acid-washed sand introduced into the depression aids materially in the disengagement of the gas as it is formed. It has been found that within a given time the volume of gas collected in a tube of this type is about 3 times as great as is the case when a Smith tube is used, the inoculum being the same both qualitatively and quantitatively. From this fact it follows that this form of tube presents the additional advantages of enabling the bacteriologist to secure evidence more quickly as to the identity of the organism concerned by the customary "analysis" by the soda absorption method of the gas formed; and, further, that the results so obtained will be more accurate for a given period of incubation.

J. P. O.

Review of Recent Patents.[1]

UNITED STATES.

Bag Filter. ***Eugene W. Deming***, of New York, U.S.A. *1,334,692.* November 2nd, 1916; March 23rd, 1920. (Six figures.)

A filter of the bag type is described, in which the bags are arranged in such a manner that they need not be removed until worn out, the several operations of filtering, washing, removing the mud, and cleaning and sterilizing all being performed *in situ*. Actually the "bags" are tubes (which may be 6 in. in diam. and 10 ft. long), the top and bottom of which are secured to suitable conduits for the purpose of introducing liquid from either end.[2] Each filter tube is surrounded by a sheath of woven wire netting, which acts as a support when the liquid is admitted under pressure. They are preferably made of seamless woven material. There are a series of such tubes (say about 12) in the casing *33* of the apparatus, connected at the top and bottom by manifolds *7* and *10* respectively.

Referring to the illustration, Figure *1* is a side elevation of the system (four units, being shown); while Figure *2* is a front elevation of Figure *1*. The manifolds *7* and *10* are connected by a pipe *14*, provided with valves *15*, *16*, and having above the valve *15*, a valved exhaust connexion *16* Each pipe *14* is connected through valve *17* to a manifold *18* extending across the end of the series of filter units, this manifold having valved connexions for air, water, and steam. The pipes *14* are similarly connected to a second manifold *19*, having a valve *20*, and inlet pipe *21*, through which the liquid to be filtered is introduced, this manifold being provided with a safety valve *64*. Each pipe *14* is also, at its lower end, connected to manifold *10* by a pipe *22* (to which is connected a pressure gauge *63*), and by pipe *23*, provided with valve *24* to manifold *25*, from which lead valved pipes *26* to the return gutter. Adjacent this gutter *27*, is a second gutter *28* for clear or filtered liquid. Mounted above these gutters are a series of swinging boxes *29* (one for each unit) arranged so that the liquid flowing thereinto from the discharge pipe *30* can be discharged into either one of the gutters. The manifold *25* has at one end a valved discharge pipe *40*, through which the mud is delivered to any suitable receptacle. The manifold *10* is a casting of a general V-shape and extends under all the filters of a unit, and is provided with screw threaded openings to receive the bottom fittings of the bag holders.

Fig. 1.

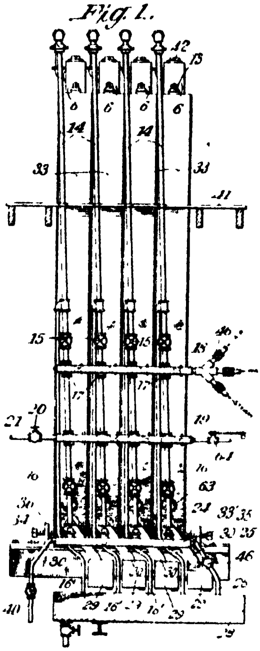
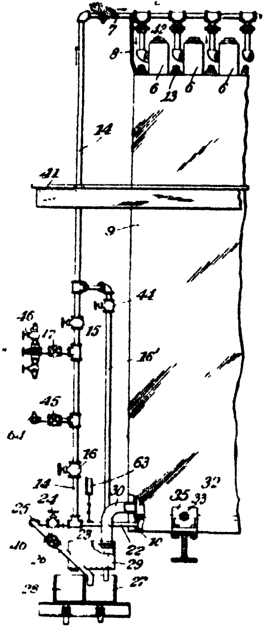


Fig. 2.



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[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France*: L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 2 fr. 00 each).

[2] In an article on this filter, it was claimed that it is suitable for the filtration of the entire cane juice in the factory after liming, thus eliminating subsiding tanks. See *I.S.J.*, 1918, 478-479.

In operating the filter bag installation, the valves *15*, *17* and *24* are closed, and valves *20*, *45* and *16* are opened; and the liquor to be filtered is delivered through pipe *23*, into the interior of the manifold *10* until it rises to the top of the bags. Liquor immediately begins to pass through the walls of the bags and casing, runs down to the bottom and is discharged through pipe *30* into box *29*, which is turned at first to deliver into return gutter *27*, as the first liquor escaping is not clear. As soon as clear liquor begins to escape, the box *29* is turned over the gutter *28* for clear liquor. The pressure on the liquor is gradually raised until the maximum desired (*e.g.* 50 lbs. per sq. in.) is obtained, by which time there will probably be deposited on the inner wall of the bag a layer about 1 in. thick. The supply of liquor to be filtered is then cut off by closing valves *45* and *16*, the valves *15*, *17* and *46* opened. Air under pressure is introduced into the top of the bags, thus forcing the liquid contents of the bags out through the bottom manifold into the return liquor gutter, whence it is delivered to the supply tank. It is preferred to use air-pressure, because it also prevents the wrinkling of the bag by holding it against wire netting. About 15 lbs. per sq. in. is used, but this is increased finally to 20 lbs. for about 15 min. so as to reduce the moisture content (and consequently the amount of sucrose remaining) of the adhering cake to a low percentage. Water is now allowed to enter the bags by way of manifold *10* under pressure rising to about 50 lbs., thus washing the cake. Lastly, the water supply valves are closed, the plugs *42* removed; and by means of a hose provided with a suitable nozzle water under pressure is used to clean off the bags, the mixture of water and mud being discharged from manifold *10* through pipe *23* into manifold *25* (valve *46* being closed) and sent to waste through pipe *40*. This cleaning of the bags can be effected at the rate of one a minute, which operation finished the unit is restored to service.

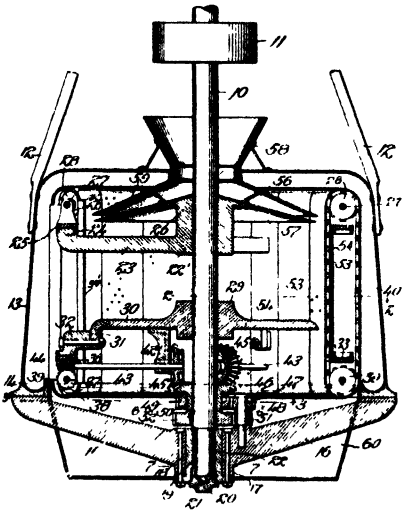
FILTER-PRESS. *Lewis Wachenberg*, of New York, U.S.A. *1,337,170*. April 5th, 1919; April 13th, 1920. (Eight figures.)

It comprises a casing or drum through which the liquid to be filtered is passed and having arranged within it a plurality of plates so made and connected that the filtrate may pass through with the maximum facility and volume. Means are also provided for applying a cleansing medium, e.g., water, through the filtering plates in a reverse direction to that of the movement of the filtrate so as to remove the deposits from the outside of the plates. Claims is made for: "The combination of a drum rotatably mounted at each end on a hollow trunnion, means to deliver into the drum through a hollow trunnion a liquid to be filtered, means to deliver the filtrate from the drum, filtering means within the drum through which the filtrate is caused to pass leaving accumulations of solid matter, means to deliver a cleansing fluid through said hollow trunnion independent of the liquid to be filtered in a reverse direction through the filtering means, means to deliver a cleansing fluid against the outer side of the filtering means simultaneously with the forcing of the cleansing fluid in the reverse direction, and means to rotate the drum during the cleansing thereof."

CONTINUOUS CENTRIFUGAL MACHINE. *Lorenzo M. Mulet*, of San Juan, P.R. *1,309,651*. May 9th, 1917; July 15th, 1919. (Eight figures.)

As the massecuite is poured into the hopper *58*, the rapid revolution of the plate *57* causes it to fly off between plate *57* and plate *59*, striking against the upper portions of the endless perforated bands *53*. By the action of the gearing (afterwards described) the sugar is carried down; while by centrifugal force the molasses passes through the perforations against the casing *13*, and out of the machine viâ the trough *14*. When the bands reach the lower sprocket wheel *39*, they bend round, thus breaking off the adhered sugar and at the same time loosening any particles clogging the perforations. On reaching the bottom point of the band, centrifugal force throws the sugar against the inner surface of the hopper *60*, from which it may be discharged. Thus the machine runs continuously, the operations of discharging the product and of cleaning the screen being carried out automatically.

Regarding the construction of the machine, it will be seen that the casing *13* is fixed and suspended by rods *12*. Secured to the trough *14* are spider arms *16* uniting in a hub *17*, within which is the bearing for shaft *10*, as clearly shown. Fixed on the shaft *10* is a spider hub *22*¹ with arms *23* having upturned ends *24*, to which are attached bearings *26* carrying sprockets *28*. A second spider hub is fixed at *29* with arms *30* and downturned ends *31*, with brackets *32* and a lower ring *33*. On this lower ring *33* are provided spaced pairs of bearings, in which are mounted the shaft sections. Around the ring *33* are disposed three pairs of bearings *36* so arranged that the pairs are equally spaced, these bearings being supported by shaft sections *37* carrying worm wheels *36*. At *39* is a sprocket wheel connected by the chain *40* to one of the sprockets *28* above. In order to effect simultaneous rotation of all the shaft sections, they are connected by means of universal joints. If now one of the shaft sections *37* be revolved by the revolution of its worm wheel, all the sections will revolve, and all the sprocket chains will be simultaneously driven.



In order to effect the driving of the worm wheels there is provided on each of the arms *30* a bearing *42* wherein is journalled a shaft *43* carrying at its outer end a worm *44* which meshes with a respective worm wheel *38*. On the inner end of each shaft *43* is a bevelled gear *45* which meshes with a bevelled gear *46* revolubly mounted on the shaft *10*. Fixed in one of the arms *16* is a stub shaft *47* whereon is revolubly mounted a gear *48* which meshes with a gear *49* fixed on the hub *50* of the gear *46*. Connected to the gear *48* is a gear *51*, also mounted on the shaft *47* and this gear *51* meshes with a gear *52* which is keyed upon the shaft *40*. It will be seen that the diameter of the gear *52* is greater than the diameter of the gear *49* and consequently the diameter of the gear *51* is less than the diameter of the gear *48*. By means of this arrangement the rotation of the shaft *10* will cause rotation of the rings *25* and *33* and thus of the shaft *43* about the axis of said shaft *10*. At the same time the gear *52* will revolve as fast as the shaft *10* but the revolution of this gear *52* will cause revolution of the gear *51* which in turn will revolve the gear *48*. The gear *49* which meshes with the gear *48* will thus revolve in the same direction as the gear *52* but at a higher rate of speed, the difference being only slight. Now the revolution of this gear *49* is communicated to the shaft *43* through the gears *46* and *45* so that consequently these shafts will revolve and in their revolution will rotate the lower sprockets *39* and cause travel of the inner portions of the chains downward and the outer portions of the chains upward when the shaft *10* is revolved in the proper direction for separation.

In order to separate the sugar from molasses there is provided a cylinder *54* which extends vertically across the inner flanges of the rings *25* and *33*, to which it is secured, and is formed of a perforated sheet of metal through which the molasses may pass as it is carried thereacross by a series of endless carriers or bands. On each of the sprocket chains is provided an endless foraminous band *53* and this band is preferably made of flexible steel or other like material. These bands inclose the perforated cylinder *54* and are arranged in three sets and each set is separated from the adjacent set by a slight space so that the arms *23* and brackets *32* can pass between the adjacent edges of the sets. In order to prevent the passage of sugar through the gaps thus left there are formed in the cylinder *54* between the opposing edges of these sets certain ridges or stops which close in these spaces.

HOLLAND.

Clarification of Juice by Filtration through a Cloth in a Centrifugal Machine. ***Louis Leefers***, of Java. *3635 ; class 89 ; group 5.* September 5th, 1919 ; May 23rd, 1919. (Two figures.)

Juice is centrifuged in a machine having a conical perforated drum, upon the inner surface of which filter-cloth is dressed. During the revolution of the drum, most of the mud accumulates in the lower outer corner, and the holes of the cloth against it may soon become obstructed. By far the greater part of the cloth above, however, is in touch with almost clear juice, which passes rapidly through this filtering surface.

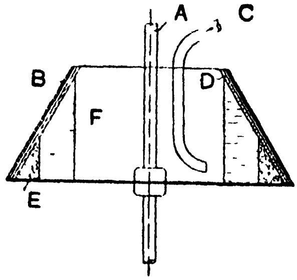


FIG 1

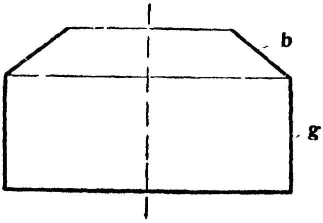


FIG 2

In Fig. 1, *A* is the spindle supporting the drum of the machine ; *B* is the conical perforated wall ; *C* is the inlet pipe for the impure juice ; *D* is the filter-cloth lying against the perforated drum ; *E* is the mud which on spinning has been forced into the lower and outer part of the drum ; and *F* is the juice which, being separated from most of the mud it contains, passes through the cloth against the upper portion of the drum. It is apparent that the surface *B* available for filtration will gradually diminish as the amount of mud *E* increases, so that finally after a time the cloth will have to be renewed. Since in the modification shown in Fig. 2 the mud space in comparison with the filtering surface is greater than in Fig. 1, it follows that the type of machine depicted in Fig. 2 can be retained longer in operation than the other before renewal of the cloths. Attention is called to U.K. Patent 15,570 of 1909 [1] In order to increase the rate of filtration, it is pointed out that wire gauze may be placed between cloth and perforated drum, thus exposing a greater area of cloth to the juice.

UNITED KINGDOM.

Purifying Used Oils. ***De Laval Separator Co.***, of New York, U.S A. *142,089 (9676)*. April 6th, 1920, *not yet accepted.*

After heating to 180°F. (82°C.), the used oil is mixed with a saponifiable oil, or a fatty acid (e.g., oleic) which is saponified by adding alkali. A counter-colloid is thus formed, which takes up the colloidal impurities, sodium chloride or sulphate being added as an anti-emulsifying agent. Lastly, the treated oil is separated by centrifugal force, or by gravitation.

Continuous Vacuum Filter. ***A E Alexander;*** communicated by ***United Filters Corporation,*** of Delaware, U.S A. *141,001 (2581* of 1920). December 30th, 1918 ; March 30th, 1920. (Three figures.)

This invention relates to continuous vacuum filters of the rotating-leaf type (e.g., as described previously[2]) wherein vertical filter leaves or discs of segmental construction are spaced apart on a horizontal revolving central shaft, the filtering units communicating with collecting valves. Claim is now made for a central-leaf supporting shaft of sectionalized construction, comprising a plurality of pipes held fixed in suitable relationship, extending longitudinally of its axis and communicating with the interiors of the sectionalized filter units by the said shaft. A collecting valve is placed at each end of the sectionalized shaft.

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[1] This relates to a process for separating oil from water and other foreign matter, in which the oil to be treated is introduced through a hollow vertical shaft and enters adjacent to the bottom of a rotary filter, travelling upwards upon and through a concentric filtering surface; see also German Patent, 245,394, in which claim is made for the use of a conical drum.

[2] U.K. Patent, 136,309.

Coating Chocolate Bonbons. *Ashjorn Sonsthagen*, of West Ealing, London. *142,259* (*8359* of 1919). April 3rd, 1919; May 6th, 1920. (Two figures.)

Chocolate bonbons are carried on endless belts or the like through two streams of coating material, the conveyors being so arranged that, after passing through one stream, the bonbons are reversed, so that the underside is uppermost when passing through the second stream. Between the two coatings the bonbons are cooled.

Cream Centres for Confectionery. *Charles W. Taussig, of the Nulomoline Co.*, New York. *143,314* (*4175*). February 19th, 1919; May 17th, 1920.

By the use of the enzyme *invertase* contained in yeast it is possible to make a centre of unusual softness, which remains soft (it is stated) 10 to 12 times longer than the ordinary centre. In order to prepare it, 45 lbs. of sugar and 10 to 12 quarts of water are "cooked" to 240° F. (116° C.); 5 lbs. of invert sugar[1] (preferably "Nulomoline") are added, and the whole cooked to 242-246° F. (117-119° C.) according to the season of the year. This mixture is poured upon a cold marble table and beaten as is usual in the making of fondent. When it is quite cold, it is worked into a fondent, and as it starts to whiten, 8 oz. of albumen previously soaked in 1 pint of water and beaten until very stiff is added. Lastly, 2 ozs. of yeast are mixed in, together with flavourings as desired.

Ageing and Maturing Alcoholic Liquors. *A. Jarrand*, of Cognac, France. *141,687* (*9321*). March 31st, 1920; convention date, April 17th, 1919; *not yet accepted.*

An apparatus and process are described for the ageing and maturing of alcoholic liquors by electrolysis, in which a depolarizing cathode and a current of low intensity are used.

Apparatus for Delivering Confectionery, Lozenges, Tablets, etc., Singly. *Fritz B Behr*, of Queen's Gate, London, S.W. *141,474 5809*). September 26th, 1919; April 22nd, 1920. (Eight figures.)

Motor Fuel Containing Alcohol. *U.S. Industrial Alcohol Co.*, of New York. *143,017* (*11,178*). May 5th, 1919; complete accepted, May 20th, 1920.

In an example given, the motor fuel is composed of alcohol (ethyl) 25 parts; kerosene, 25 parts; gasolene, 25 parts; and chloroform 9 parts. Instead of the chloroform any "chlor-hydrocarbon" may be used, e.g., carbon tetrachloride, trichlorethane or tetrachlorethane.

Motor Fuel Containing Alcohol. *U.S. Industrial Alcohol Co.*, of New York, U.S.A. *140,796*, *140,797* (*8796*; *8797*). March 25th, 1920; convention date, October 12th, 1917; *not yet accepted.*

The fuel comprises gasolene, kerosene or other petroleum distillate, and alcohol, as ethyl or methyl, and a "blending agent," as (1) an aromatic nitro-compound (e.g., a nitro-benzene, or a nitro-toluene); or (2) a phenol (e.g., carbolic acid or cresol). Other blending agents, as acetone, benzol, and toluene, may be added.

Motor Fuel Containing Alcohol. *H. Wade* (*C. J. M. M. Le Petit*, of Mombasa, British East Africa). *141,091* (*18,039* and *19,134*). November 4th, 1918.

Alcohol and ether mixtures or other fuels for internal-combustion engines are mixed with a small proportion of one or more aliphatic amines and esters of formic acid. The amines mentioned are methylamine, dimethylamine, trimethylamine, and ethylamines, suitable mixtures being obtained from vinasse or from herring brine. The esters specified are ethyl and methyl formates.

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[1] *I.S.J.*, 1917, 237.

Cocoa Manufacture. *Frederick E. Whitham*, of Sowerby Bridge, Yorkshire. *141,953* (*13,819*). May 31st, 1919; April 29th, 1920. (Six figures.)

A continuous process of cocoa manufacture is described in which the beans or "nibs" are subjected to a grinding or re-grinding operation in a heated chamber, the ground portion being subsequently separated from the partly ground, and the butter fat or chocolate subsequently separated from the ground portion or cover, both being separately delivered into moulds or the like for use for different purposes.

Production of Alcohol from Seaweed. *Eric C. Bayer, and Sigurd Orlajensen*, of Copenhagen, Denmark. *119,030* (*14,046*). May 14th, 1919; May 14th, 1920.

An aqueous extract of seaweed is hydrolysed with a small quantity of acid in order to obtain fermentable sugars, which are subjected to further treatment in the usual manner for the production of alcohol.

Lubricants. *Henry M. Wells*, of South Drive, St. Anne's-on-Sea, Lancs., and *J. E. Southcombe*, of Beaufort Road, Birkenhead. *130,377* (*2055*). February 5th, 1918.[1]

Lubricating oils are prepared by adding to a hydrocarbon lubricating oil, a minute amount, e.g., 1 to 2 per cent. of a substance other than soap which lowers the interfacial tension between oil and water. Where it is desired to prevent the product from forming an emulsion with water, acids of molecular weight, such as butyric or other volatile fatty acids, cinnamic acid, or water-soluble naphthenic acids, are added to the mineral lubricating oil. A product which is emulsifiable with water and suitable for marine-engine lubrication is obtained by the use of higher fatty acids such as those obtained from rape oil, wool grease, or whale oil. Olein and other commercial fatty acids are preferably employed, the products so obtained being very similar to those obtained by compounding the corresponding animal and vegetable oils with mineral oils. The hydrocarbon oil may be derived from petroleum, coal, coal-tar, shale, colophony, etc. Petroleum jelly also is used.

UNITED KINGDOM COMPLETE SPECIFICATIONS ACCEPTED.[2]

Rotary Suction Filters. *United Filters Corporation*. *146,231* (*17,538*). May 24th, 1917.

Manufacture of Fertilizers. *Akt.-Ges. für Anilin Fabrikation*. (1) *146,259* (*17,608*). January 29th, 1918. (2) *145,582* (*17,720*). March 16th, 1918.

Sand Filter. *N. M. Barron*. *146,577* (*8402*). April 3rd, 1919.

Heat Exchange Apparatus. *F. Duvieusart*. *146,579* (*8424*). April 3rd, 1919.

Soil Sterilizer. *Hawker & Botwood*. *146,678* (*12,397*). May 16th, 1919.

Anti-Corrosion Composition. *C. A. Allison*. *146,676* (*12,186*). May 15th, 1919.

Evaporator. *Grimson-Russell Co*. *146,730* (*18,718*). July 28th, 1919.

Extracting Materials. *Elektro-Osmose Akt.-Ges*. *146,453* (*18,521*). July 3rd, 1919.

Conversion of Cellulose into Sugars. *A. Wohl*. (*1*) *146,455* (*18,526*). March 14th, 1917. (*2*) *146,860* (*18,744*). April 7th, 1917.

Manufacture of Rice Starch. *Reckett & Sons and C. H. Hardy*. *147,255* (*8471*). April 7th, 1919.

Evaporators. *G. A. Krause*. *132,256* (*21,553*). July 11th, 1917.

Filters. *A. Tixier*. *147,581* (*19,516*). December 12th, 1913.

Manufacture of Sugars from Cellulose. *Zellstofffabrik Waldoff*. *147,232*; *147,416* (*19,313*; *19,314*) October 19th, 1916; April 18th, 1917.

Preparation of Beets for Food Manufacture. *Betavit Ges*. *147,713* (*19,707*). December 17th, 1917.

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[1] Also U.S. Patent, *1,319,129*.

[2] The date given is that of application.

Patents.

Separation of Scum from Liquids. *S. H. Adams. 145,291 (19,049).* August 1st, 1920.

Liquid Fuel Spraying Device. *Babcock & Wilcox and A. Spyer. 145,320 (24,459)* October 9th, 1919.

Straining or Filtering Apparatus. *F. C. Fulcher. 145,339 (28,170).* November 13th, 1919.

Centrifugals. *C. A. Fesca & Sohn. 145,397 (979).* June 18th, 1919.

Filling Sugar Moulds. *H. Delvenne. 145,526 (16,910).* September 20th, 1918.

Motor Fuel. *U.S. Industrial Alcohol Co. 128,915 (16,124).* June 25th, 1918.

Apparatus for Raising the Temperature of Liquid Fuel for Use with Internal Combustion Engines. *J. H. Stirk. 146,045 (31,342).* December 15th, 1919.

Boilers. (1) *J. Baron. 145,981 (16,512).* July 2nd, 1919. (2) *Stirling Boiler Co.. and H. J. S. Mackay. 146,050 (32,807).* December 31st, 1919. (3) *G. E. Canhac. 138,606 (2447).* February 4th, 1919. (Addition to *5391* of 1915). (4) *R. H. White and E. R. Newton. 145,554 (17,664).* July 2nd, 1919.

Cane Crushing Mill. *Fulton Ironworks Co. 146,280 (17,136).* January 13th, 1917.

Revised Sugar Prices in the United Kingdom.

The Royal Commission on the Sugar Supply announces the following statement of revised sugar prices for Period 8 — 12th July to 7th August, 1920 :—

Class.	For Grocery Purposes.		For Manufacturing Purposes and Ships' Stores.
	Wholesale per cwt. Discount 1¼ per cent to direct buyers.	Approved retail price per lb	Wholesale per cwt. Discount 1¼ per cent to direct buyers
0. Castor, Icing, Pulverized	118s.	1s. 2¾d.	151s.
1. Cubes, Loaf Sugar	116s.	1s. 2½d.	149s.
2. Granulated, Crystals, Crushed, and Chips, Dry White Sugar, W. I. Grocery Crystallized Yellow Crystals, White Pieces (moist)	112s	1s. 2d.	145s.
3. W.I. Muscovado (moist) Pieces (other than White), W. I. Grocery Syrups	95s. 9d.	1s.	100s.
4. Jellies, Knots, Lumps, and other Low Grade sugar to be sold only to manufacturers	—	—	Uncontrolled

Sugar for domestic preserving will be issued at :—

	Wholesale per cwt. Discount 1¼ per cent. to direct buyers.	Approved retail price per lb.
Yellow Vouchers (authorized allowance)	114s.	1s. 2d.
Green Vouchers (free sugar)	146s.	1s. 6d.

Licensed Free Sugar.—The maximum "reasonable" price for all licensed "free" sugar from July 12th until August 7th, 1920, has been fixed at :—

Wholesale per cwt Discount 1¼ per cent.	Retail per lb. For domestic preserving only.
146s.	1s. 6d.

Syrup and molasses will be sold by refiners at prices approved by the Commission.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1920. Tons.	1919. Tons.
Total Receipts January 1st to July 22nd	1,976,757	1,824,257
Deliveries ,, ,, ...	1,976,757	1,820,257
Meltings by Refiners ,, ,, ...	1,696,545 ..	1,749,000
Exports of Refined ,, ,, ...	320,000 ..	260,000
Importers' Stocks, July 21st	— ..	4,000
Total Stocks, July 21st	96,189 ..	86,747
	1919.	1918.
Total Consumption for twelve months	4,067,671 ..	3,495 606

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1917-1918, 1918-1919, AND 1919-1920.

(Tons of 2,240 lbs.)	1917-18 Tons.	1918-19. Tons.	1919 20. Tons.
Exports	1,975,231 ..	2,122,663 ..	2,690,502
Stocks	899,716 ..	1,153,407 ..	605,308
	2,874,947	3,276,070	3,195,810
Local Consumption..	58,700 ..	55,000 ..	47,700
Receipts at Ports to June 30th	2,933,647 ..	3,331,070 ..	3,243,510

Havana, June 30th, 1920 — J. Guma.- L. Mejer.

Beet Crops of Europe.

(Willett & Gray's Estimates to July 22nd, 1920.)

	Harvesting Period.	1919-20. Tons.	1918-19. Tons.	1917-18. Tons.
Germany	Sept.-Jan...	750,000	1,411,900	1,541,061
Czecho-Slovakia	Sept.-Jan...	535,000	700,000	668,250
Hungary and Austria	Sept.-Jan...	50,000		
France	Sept.-Jan...	154,444	110,096	200,265
Belgium	Sept -Jan...	127,700	72,000	129,000
Holland	Sept.-Jan. .	236,277	173,436	199,295
Russia (Ukraine, Poland, etc.)............	Sept.-Jan...	225,000	700,000	1,028,580
Sweden	Sept.-Jan. .	145,000	127,467	125,000
Denmark	Sept.-Jan...	160,000	144,600	136,800
Italy	Sept.-Jan...	150,000	100,000	100,000
Spain..................................	Sept.-Jan...	81,650	139,409	134,955
Switzerland	Sept.-Jan...	4,000	4,000	4,000
Bulgaria	Sept.-Jan...	15,000	16,000	22,000
		2,634,071	3,698,908	4,289,206

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

Notes and Comments.

The Consumption at Home: Increased Ration.

The Royal Commission announced last month an increase in the ration of sugar from 8 oz. to 12 oz. per head, thereby returning to the allowance that was in force from January to October, 1919. It had not been anticipated that they would make the change so soon, with four months of 1920 still to run; but the calculations made eight months ago as to the rate of consumption not only in the United Kingdom but in other big sugar consuming countries of the world have not been fulfilled. It remains the case that there is not enough sugar produced in the world to satisfy the normal requirements of the world consumer, when sold at a reasonable price. But it is clear that the abnormal price of sugar has temporarily stifled consumption, hence the world markets are not taking up the sugar so fully as was anticipated. Surpluses therefore exist and will continue in all probability to exist well into the new crops unless the price falls sufficiently in the meantime to tempt buyers. As we write, prices are already showing a downward tendency and may fall considerably ere long.

In the United Kingdom it is clear from the brief explanation given by the Royal Commission for their action (as reproduced on another page) that consumption at home has not averaged the ration of even 8 oz. per head per week, owing to the price being too stiff for the poorer members of the community, hence the stocks of sugar are greater at the moment than was allowed for at the beginning of the year. The wholesale users, too, have not been taking up the maximum amounts allowed them; at the prices they feel bound to ask for their products the public are not buying so freely as of yore. The orgy of spending on the part of the newly rich that was a feature of 1919 has evidently slackened off. Moreover, we believe that the Royal Commission have by buying up here and there secured for the current year a larger quota of sugar than the 1,100,000 odd tons they had fixed for the 1920 consumption of this country. So with the prospect that the American consumption too will be below anticipations, they evidently feel confident that it is safe to allow a bigger ration to those who care to buy it. And not only have they increased the white sugar ration to 12 oz., but they have put West

Indian brown sugars on the free list, to be bought *ad lib.* at any shop by those who care to apply for them.

In taking this step it is believed that the Royal Commission are also actuated by the wish to ascertain more accurately what the normal consumption is likely to be while sugar is at a comparatively high price, so that the date for de-controlling sugar can be more readily fixed. The general intention has been, we believe, to retain control at least till September 1921; but if with sugar partly freed and a bigger and somewhat cheaper ration of the best sorts allowed, the consumption does not run ahead of probable supplies, it is possible that de-control may come sooner than the date above mentioned. The present step would therefore appear to be a feeler, and the result of the freer supply coupled with a probably somewhat cheaper price in the near future should provide data for deciding when the market may be safely freed from Government control and left to its own devices without endangering the consumer's interests.

Imperial Trade Relations with the British West Indies.

Imperial trade relations with the British West Indies have just lately been marked by two decisions, one that must be deemed a retrograde step, and the other a progressive achievement. The retrograde step is the decision of the Royal Mail Steamship Line—inevitably from their point of view—to discontinue the direct mail and passenger service between the United Kingdom and the British West Indies. The passenger service—always at best a small seasonal one—has for some time past been run at a considerable loss, and this loss has been enhanced by the high price of bunker coal. As the old mail subsidy allowed the Company by the Government expired in 1915, and has not been renewed, the Company have no further incentive to continue the service; hence the sudden announcement of its abandonment last month. The immediate result is that intending passengers to the West Indies from this country have to proceed as a rule either via New York or via Halifax, at a corresponding loss of time and money.

We have called this a retrograde step, because just now, when there is every prospect of improved trade relations between the mother country and the West Indian colonies, it seems a thousand pities that the means of communication should be curtailed in this drastic fashion. From the steamship company's point of view the step may be necessary as a commercial proposition, but it ought not to be beyond the Government's powers to so assist it financially as to restore at least partially the old facilities. Actually, the question of Imperial transit facilities is under consideration by a departmental committee, and it may be that they will recommend the Government to re-establish a subsidy for the West Indian route. We trust it will prove so.

The progressive achievement is a trade agreement resulting from the conference between delegates representing the United Kingdom, Canada, and the British West Indies, that was held in Ottawa last June. Three main matters were there discussed: Imperial Preference, Shipping, and Cable Communication, and an agreement has been come to which should go far to facilitate and extend the trade of the British West Indies. Reciprocatory preferential tariffs have been arranged between Canada and those Colonies, while there is of course already the preference on sugar accorded them on entry into this country. Moreover, British Honduras and Jamaica, which have hitherto held aloof from these reciprocatory proposals, are now participants. An improved shipping communication between Canada and the Islands is eventually to be established under a subsidy contributed in certain agreed proportions by both sides.

Although the reciprocity arranged by this conference is more immediately between Canada and the West Indies, the latter's delegates, we gather, expressed themselves in favour of giving equal preferences to the rest of the Empire, and it was laid down that the new agreement should not prevent any such preferences, whether existing already or to be established later on. We give elsewhere the official details of the amendment effected in the Canadian customs tariff to admit West Indian sugar under the new arrangements. The noticeable feature is that the antiquated Dutch standard is still to be retained, owing, as the *West India Committee Circular* avers, to the Canadian refiners having maintained an uncompromising opposition to any change which would admit of West Indian sugar going into direct consumption. A *modus vivendi* was arrived at, and the use of the standard is to be waived whenever sugar is to go direct to a refinery, which should prevent any "refining sugar" being prejudiced on account of its colour. This notwithstanding, we think it a pity that any such obstacle should be perpetuated by a Dominion Government against the inclination, if any, of the producers to turn out direct consumption sugars. After all, these sugars are for consumption within the Dominion, and one would suppose that the consumer also had some right to a say in the matter, especially when his pocket is affected.

Argentine Sugar: A Threatened Government Embargo on Exports.

Writing at the end of May our Argentine correspondent stated that prospects were bright for the crop then commencing inasmuch as the Government had removed the prohibition on exportation for at least 90 days, and as a consequence it was expected that some 100,000 tons of their excess stock of sugar would be exported, and thus stabilize the market. Since then this quantity has been speedily disposed of, chiefly to the United States, and the permission to export has had to be quickly rescinded to prevent the bulk of the crop going the same way to the detriment of the Argentine consumer. The permission to export was given on the strength of an assurance that the home price would be kept down to 55 cents the kg., or say 5d. per lb. But between May and July the retail price went up in Argentina, till at the end of July it was about 11d. to 1s. 2d. per lb. This stirred the Government to take action, and in August they were seriously considering a proposal to expropriate 200,000 tons of the crop at practically cost price, or say 40 to 50 per cent. below the current world's price. British capital being very strongly represented in Argentina, and one of the leading sugar factories in Tucumán being British, the report has attracted some attention in the financial columns of the leading London papers, where the Argentine proposal is looked upon as tantamount to a breach of faith towards British and foreign investors in Argentine property. As the *Times* remarks, "the project under notice goes much further than a mere embargo on exports. To force the growers to sell at a price that bears no real relation to current prices and which leaves them with little or no profit is a breach of the faith on which British and foreign investors have advanced funds for the development of the Argentine sugar industry." If this policy is allowed in the case of the latter industry, it is feared other industries on the River Plate, in which enormous amounts of British capital are invested, may not be safe from similar arbitrary Government interferences. The latest news at the time we write is that the Bill to authorize the expropriation has passed the Chamber of Deputies only after 15 hours' continuous debate, and there is some hope that it will be modified by the Senate, and made less drastic.

Naturally the proposed expropriation was not to be confined to foreign-owned sugar properties; the Argentine ones would suffer similarly. If authorized it appears to establish the third instance where the Government of a country, having an indigenous sugar industry that more or less supplies the home consumption, has lent its ear to the demands of the consumer and has arbitrarily curtailed the price of the producer. As our readers know, both in Australia and in South Africa the last few years there has been continuous strife between the consumers and the producers of sugar, and the Government has in each case fixed on maximum prices which, while hardly satisfying the unreasonable demands of the consumer, have shackled the producer in respect to the prices he could charge. In each case the prices have been fixed more or less fifty per cent. below the world's price. It has been attempted, in fact, to base the price of sugar on the local fancy of what it ought to be, irrespective of the fact that the prices of other things have not been kept down, e.g., wages, and the cost of replacement of factory plant or new machinery, much of which has to be imported from parts of the world where the new scale of high prices is in full force. Unless these sugar regions are fully self-supporting and uninfluenced by the rising costs in other parts of the world, it is futile, not to say unjust, to expect a particular industry domiciled within them to maintain a price for its production greatly below that of the world's normal price at the present day. This fact seems to be slowly dawning on the South African Government, for they have now further revised the producer's prices they fixed last May of £41 per ton (as outlined by us in our Notes and Comments last month), and from August have fixed the maximum price for first quality sugar at £51 per ton, or the price the Mauritius planters got from the Royal Commission in 1919. In Australia, the producer has still to be content with £30 6s. 8d.

While agreeing that the English press is justified in complaining about the proposed expropriation in Argentina, we do not remember that they have ever raised the point in respect to the similar arbitrary interferences in South Africa and Australia, though in South Africa, we believe, some of the mills are partly financed with home capital. Doubtless the amount at stake was not enough to warrant a complaint, whereas in Argentina British capital has very large commitments. The result is the British press takes up the cudgels on behalf of the Argentine sugar industry, while the analogous case in our two above-mentioned Dominions escapes their notice.

Recent Argentine Legislation.

Meanwhile it may be convenient to give here the official report of recent Argentine sugar legislation as compiled by the Commercial Secretary to H.M. Legation, Buenos Ayres, and just lately published as a Parliamentary paper.[1] This does not of course bring us down to the latest proposal, but it reveals some of the previous attempts on the part of the Argentine Congress to control the price of sugar to the consumer. According to this Report, the province of Tucumán normally produces three-fourths of the total yield of Argentine sugar, but failure of the crop in that province, due to frosts, leaves the more sub-tropical provinces of Jujuy and Salta comparatively immune. The crop of 1918 was a failure, and in consequence the importation of 130,000 tons free of duty was authorized. Law No. 8877, of 1912 permits the Government to authorize such importation when the price of refined sugar in bags exceeds $4·10 paper per 10 kilos in Buenos Ayres. The harvest of 1919 was the best for many years, but nevertheless the Government prohibited the export of sugar in August of that year and subsequently, by Decree dated 8th November, declared that although the reasons invoked by manufacturers alleging a higher cost of production are worthy of attention, it is impossible to remove the export prohibition so long as refined sugar is sold locally at $4·10 paper per 10 kilos[1] and so long as manufacturers do not give ample assurances that quotations will not exceed that price. A proposal is before Congress, and has been passed by the Finance Committee, revoking the present system of import duties and substituting for a period of six years, counting from the promulgation of the new law, the following fixed customs duties:—6 cents gold per kilo of refined sugar or of 96 degrees and more of polarization; 4 cents gold per kilo of unrefined sugar or of less than 96 degrees of polarization.

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[1] Report on the Economic and Industrial Situation of the Argentine Republic for the Year 1919. [Cmd. 895.]

Furthermore, the project establishes that as long as the Provincial Government of Tucumán maintain the taxes on sugar manufacture lately imposed, the equivalent of such taxes will be deducted from the new customs duties. Similarly, any new sugar taxes that may be imposed in the future in the producing Provinces will be deducted from the new customs duties while the taxes are in force. By another article of the project, any ordinance restraining the import or export of sugar would be abolished.

Cuban Costs and Prices.

Facts about Sugar collates several opinions from prominent Cuban sugar men as to the outlook in the matter of crop and prices. The largely increased cane acreage promised for next season is considered by many too optimistic, the growing cane in many places having been affected by drought on one hand or too much rain on the other. Then the increase in production will depend on the availability of labour and here the outlook for next season is not bright, as the present shortage of labour (which at the present day on some estates hardly allows the fields to be kept free from weeds) is bound to become more serious. The general opinion appears to be that the new crop sugar will command a price round 15 cents. One thing is agreed, and that is that the low prices of former seasons are a thing of the past. It stands to reason that if a sugar mill costs twice as much as formerly, the price of sugar must be proportionately higher. The same thing applies to wages. Low class Haitian labour that formerly was paid about 80 cents a day is now commanding $4·50 [18s. at pre-war rates of exchange]. Chinese labour is being used to some extent on indoor jobs, where the same process is repeated over and over again, but is no use outside. The price of Spanish labour, which is the best obtainable, has risen in proportion. A gang that would contract to clear about 30 acres for $300 a short time ago is now demanding $1000 for the same work. Clearing and planting a caballeria which formerly cost something like $3000 now costs double, and if the cost of cutting and the later operations is as heavy, it will mean that sugar prices will have to be considerably higher than previous levels.

The same source of information states that it is the speculators and the colonos who have made money over the 1920 crop. The mills have not made abnormal profits, and in some instances they sold sugar for future delivery at 6·50 cents and then were obliged to settle with their colonos on a much higher basis. The fact that the colono could not get into the market until he had grown his cane was the making of him this year. The colonos have now paid off their debts and are spending money right and left. "The speculators," said one Cuban business man, "have been active in Cuba, and Englishmen got sugar cheap. I know of several contracts that have changed hands seven or eight times before the sugar was finally shipped."

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[1] Say 4d. per lb. at par values.

Cuban Sugar Properties.

Some interesting data are given in a recent number of our same contemporary covering the numerous changes in the ownership of properties in Cuba that have latterly taken place. Three notable tendencies, states our contemporary, are observable in these transactions which in turn reflect the marked changes that are taking place in the sugar industry of the world at large. In Cuba these tendencies may be classified as follows: First, the beginning of a movement, destined to grow, towards the acquisition of producing properties by American refiners; second, the purchase by manufacturers of the United States of Cuban mills and plantations in order to ensure their supply of sugar; and, third, a growing interest on the part of the United States investors, not directly connected with the sugar industry, in sugar mill properties. The number of mills and plantations that have changed hands during the last six months represents values extending to hundreds of millions of dollars. The full value cannot be stated, but it is known that these sales far exceed the total of any similar transactions for at least ten years past. It is estimated indeed that American capital now controls and is interested in approximately 60 per cent. of the sugar production of Cuba.

As far as the refiners are concerned, their old policy of holding aloof from the field of sugar production has been abandoned in favour of a policy of securing through the ownership of Cuban sugar mills a steady source of supply at a reduced cost for their refineries; their action in this respect has undoubtedly been expedited by the fact that Cuba is now alive to the possibilities of the production of direct consumption sugars instead of 96° raws for the refinery, so the refiners are anxious to safeguard their future by acquiring the means to turn out raw sugars for their refineries.

The American Sugar Refining Co. have thus secured Centrals Cunagua and Jaronu, which will between them provide some 171,430 tons of raws. The Warner Sugar Refining Company have acquired a controlling interest in Centrals Gomez Mena and Amistad, with a total of nearly 90,000 tons. The Revere Refinery at Boston has had for some years the Centrals Boston and Preston, and is now rumoured to be after additional mills. Finally, the National Sugar Refining Co. is seeking to acquire mill properties in both Cuba and St. Domingo. Of American manufacturers, the most prominent is the Hershey Chocolate Co. of Pennsylvania, who built Central Hershey several years ago.

It remains to be seen whether British refiners will copy the example of their American rivals and seek to acquire sugar properties in some or other sugar territory. It is not impossible that the recent visit of one British refiner to India has been made with a view to ascertaining what prospect that country holds out of providing the British houses with a steady supply of raws for refining. In any event, unless these refineries are to go back to the refining of beet crystals, the advancing tendency in cane sugar practice to resort to the manufacture of direct consumption sugars is bound to be a menace which they cannot afford to ignore.

The Formosa Sugar Crop.

According to Consular information from Formosa, the 1919-20 sugar season there has yielded much better results than was expected after the typhoon of August, 1919. The production of centrifugals came to 3,511,467 piculs [213,447 long tons] as compared with 4,519,290 piculs [274,708 long tons] in the preceding season; but that of brown sugars only amounts to 220,000 piculs [13,373 long tons] compared with 536,000 piculs [32,581 long tons] in 1919.

Notes and Comments.

The Mauritius New Crop.

Messrs. Blyth Brothers & Co.'s *Market Report*, dated June 15th, stated that the negotiations proceeding with the Royal Commission culminated in the sale to that body of an estimated quantity of 205,000 tons of Vesous at 91s., 90s., 89s. per cwt. f.o.b. according to grade, payable 54,000,000 Rupees in India and Mauritius at Rs. 10 to the £, and the balance in London. As was only to be expected the news that the Royal Commission were offering such a high price caused great excitement in the local market where, up to this time, they had heard no mention of a higher price than 85s.; but together with the offer of the Commission came news from outside sources pointing to the fact that planters might expect 100s. and even 120s. per cwt. f.o.b. It was therefore decided to ask the Commission to increase their offer to 100s. but they were unwilling to do so in view of the sudden heavy decline which then took place in the New York market and in those of Cuba and Java.

A small section of the planting community were in favour of refusing the price of 91s., but five-sixths of the planters considered that the price offered was not one to be declined, (especially in view of the indications that the market had touched its highest point and the difficulty of financing the crop without the assistance in currency which the Royal Commission were arranging for), so the remainder when they saw what a large majority had accepted the Commission's offer gave way rather than be excluded from the sale, and sold their sugar at the same price.

The prospects of the coming crop are not now so favourable as at one time looked likely owing to the continuance of the drought which began in the early days of May. It has been proved in the past that an average drought in Mauritius does considerably more harm to the canes than even a fairly bad cyclone, and the Government Statistician has greatly reduced his previous estimates of the crop which he now puts at 240,000 tons instead of the 275,000 to 280,000 tons previously mentioned.

A Lucrative Post in Jamaica.

As will be seen elsewhere in our advertising pages,[1] the Crown Agents for the Colonies are advertising for a manager for the new sugar central to be built in Jamaica under the aegis of the Jamaica Government. A month or two ago it was reported that the latter Government were advertising in Cuba and other non-British countries for such a superintendent, but the details of the present advertisement have narrowed down the choice very considerably; almost too considerably, we suggest. It seems right that the post should be given to a British subject, but the age limit will preclude more than one good man who might otherwise be eligible and the restriction to those who have had recent experience of *English* machinery (What is wrong with the world-famous Scotch machinery, we wonder?) will narrow the field considerably and rule out the valuable experience which many suitable candidates have gained in Cuban, Hawaiian, and Java sugar factories where the machinery is largely non-British. We think the real thing is to secure the best man of British nationality and sympathies that is to be got, and judge his qualifications by his experience in up-to-date sugar manufacture without specifying too narrowly what machinery he has handled. That the factory wiil be equipped with British machinery hardly affects the argument.

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[1] See page xlvii.

Fifty Years Ago.

From the "Sugar Cane," September, 1870.

An anonymous writer contributed in this issue of our predecessor an article advocating the manufacture of white sugar on the plantation, stating that "if full scope were only given to manufacturing appliances, refining, defined as a second purifying operation, should not be necessary at all." He therefore presented "such a sketch of home sugar refining as should enable a colonial sugar producer . . . . . . to judge in how far refining operations may suit his own case." That the unnamed writer was a practician is apparent from a perusal of his paper.

Dr. WALLACE contributed an article on animal charcoal, covering very much the same ground as in his previous paper on "Sugar Refining" which we have already noticed.[1] He had made a study of the nitrogen content of char, showing the amount to diminish during use, and added that although unprepared to state "whether this nitrogen plays an important part in the decolorizing action exerted by charcoal, one thing is certain, and that is that we know of no variety of charcoal that is really a good decolorizing agent that is not made from a highly nitrogenous substance. Wood charcoal, for instance, although eminently porous, is a very poor decolorizing agent, and is practically useless." He had also given attention to the changes that occur in the physical nature and chemical composition of char during revivification by reburning, and remarks that "these facts prove incontestibly that the pores of old char are either smaller or less numerous than in new char; and I think it is a fair conclusion that, if we wish to retain the char in an efficient state, we should burn it so as to lessen the porosity as little as possible. Indeed, it appears to me that the revivifying of charcoal by *burning* is an unfortunate necessity, and one which we may very reasonably hope to overcome."

This view was held also by others, and at this time consideration was being given to Eisfeld's process for revivifying without calcination,[2] a description of which procedure was given in this number by M. CORNILL WOESTYN. It appears that char was first allowed to ferment by soaking in water, and afterwards successively acted upon by hydrochloric acid, steam, and a dilute solution of ammonia. No shrinkage of the material occurred when treatment was made in this way, while the working costs were stated not to be high. This process was put into operation in factories in Germany, Austria, and France; but it was worked only experimentally in this country.

Other articles that appeared in this issue dealt with "The Sugar Industry in Antigua;" "Facts about Louisiana;" and "The Continental Beet Crop and the War," in which last it was stated that the French sugar trade was in the greatest confusion, the refiners doing scarcely anything. "They employ many Germans who have either been called to serve in the Landwehr or have been expelled from France by the Government; then the call on all able Frenchmen up to 40 will further diminish their staff of workmen." There was an important patent by ROUSSEAU[3] protecting his method of operating the saccharate process in beet sugar manufacture, in which the juice was concentrated to a syrup of 35° Bé. and limed, the precipitated compound being separated on sieves, and subsequently decomposed with carbon dioxide in a special vessel.

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[1] *I.S.J.*, 1920, 12. [2] *I.S.J.*, 1920, 302. [3] English Patent, 98 of 1870.

The Sugar Supply of the United Kingdom.

Royal Commission Announcements.

From August 5th the only article of food rationed within the United Kingdom has been sugar. The regulations dealing with it have been embodied in a brief new Order (the Sugar Rationing Order, 1920), but these are merely a continuation of the old regulations.

The Food Controller announced on August 7th that the supplies of sugar either now in the hands of the Royal Commission on the Sugar Supply, or purchased for future arrival, had rendered possible an increase in the weekly ration from 8 ozs. to 12 ozs. which would be authorized as from 9th August.

There are now also available supplies of West Indian grocery sugars (Crystallized and Muscovado) of which the special qualities are highly appreciated by many consumers. In order to assist the restoration of this important industry within the Empire, the Food Controller has given instructions that on and after September 6th these coloured sugars imported from the British West Indies or Demerara may be sold retail without reference to and in excess of the authorized ration, to registered or unregistered customers, at prices not exceeding those authorized by the Royal Commission for the time being for "Free Sugars." Coloured sugars of grocery quality produced in refineries in Great Britain will be treated on the same footing. It has been found possible to make these modifications in the sugar restrictions in consequence of the saving that has been effected during the past six months and of the amelioration that has taken place in the world's supplies in consequence of the diminution of consumption due to the high price prevailing generally.

The Food Controller announced, on August 16th, that until the second or third week in September there would be included in the sugar ration, as heretofore, a certain proportion of brown moist sugar; by the middle of September, the additional supplies of white sugar which had been arranged for would be in the hands of retailers, who would then be authorized to supply the whole of the present ration of 12 ozs. in the form of white sugar. After September 6th, the public would be free to purchase brown moist sugar in addition to the weekly ration of 12 ounces. These purchases of brown moist sugar could be made after September 6th at any shop, and need not be confined to the shop at which the customer is registered for his rationed quantity.

The Sugar Prices in force for the period 12th July–7th August (as given in our last issue, on page 479) were slightly modified for the period, 9th August to 4th September. The wholesale prices for manufacturing purposes were reduced by 5s. per cwt. for all classes except No. 3. Thus Castor was reduced to 146s., Cubes to 144s., Granulated to 140s., and West Indian Muscovado and Grocery Syrups to 97s. The free sugar for domestic preserving was reduced 5s. per cwt. wholesale (to 140s.) and the retail price reduced to 1s. 5½d. per lb. A similar reduction in the respective prices of "Licensed Free Sugar" was likewise made. Otherwise the prices remained unchanged from July.

Cables from South Africa announce that the further negotiations with the Union Government on the part of the sugar producers have resulted in the latter agreeing to raise the maximum price of first quality sugar another £10 per ton to £51 per ton. This, while not fully meeting the needs of the producers who ask for at least 75 per cent. of the world's price, will undoubtedly easen the situation. The various changes in the price of South African sugar the last two years have been as follows: October 1918, £23; June 1919, £26; May 1920, £41; August 1920, £51.

The Sugar Industries of Canada.

(From a Canadian Correspondent.)

A considerable amount of interest is being felt at the present time in Canada as elsewhere in the question of the production of sufficient supplies of sugar both for domestic use and for the important chocolate and confectionery industries which have made such strides during the war and since the Armistice, and an increased acreage is being devoted in certain districts to the production of sugar beets. Sugar beet was first grown for industrial purposes in Canada in 1881 and during the ten years following that date plants were set up at Coaticook, Berthier and Farnham in the Province of Quebec, each of these proving a failure after a short trial. Beet sugar manufacture was, however, resumed in 1901, this time in the Province of Ontario, plants being opened at Wallaceburg, Dresden, Wiarton and Berlin (now re-named Kitchener), and in 1903 the plant at Raymond, Alberta, was inaugurated, and continued in operation until the outbreak of the war in 1914. The Dresden and Wiarton plants had but a short life, but the Dominion Sugar Company, Limited, still carries on the plants at Kitchener and Wallaceburg, in addition to another at Chatham, Ont. The production of sugar beets in Canada last year reached some 240,000 tons, worth $2,606,000, raised from an acreage of 24,500 acres, all in Ontario, as compared with 180,000 tons, worth $1,845,000, raised on 18,000 acres in 1918, the yield per acre having fallen from 10 tons per acre in 1918 to 9·80 tons per acre last year.

The output of beet sugar in Ontario is of course very far from supplying the needs of the population of our premier Dominion, who are estimated to be consuming sugar at the present time at the rate of 110 lbs. per head per annum, or 963,200,000 lbs. (430,000 tons) altogether, and consumption is continually increasing, no doubt in part owing to the restriction of alcohol sales in so many of the Canadian provinces. During the twelve months ended March 31st last, the importation of sugar into Canada amounted to 483,353 tons, as compared with 320,975 tons in 1918-19 and 298,218 tons in 1913-14. Exports of refined sugar during the corresponding periods amounted to 109,519 tons in 1919-20, 916 tons in 1918-19 and under 1 ton in 1913-14. Of the exports from Canada last year, 57,904 tons went to the United Kingdom, much of it being sugar refined in the Dominion for account of the Royal Commission on Sugar Supplies from imported materials. France took 30,782 tons and 4,800 tons were shipped to Newfoundland. Most of the raw sugar imported into Canada for refining comes from Cuba, where Canadian financiers have secured an important measure of control in some of the plantations. Quite a large proportion of the crop, however, reaches the Dominion by way of the United States, with the result that last year imports from that country are recorded as 152,011 tons, only 117,892 tons being directly credited to Cuba. Supplies of raw sugar are also obtained from British Guiana, the quantity received last year being 45,914 tons; from Barbados, 33,281 tons; Jamaica, 8717 tons; San Domingo 75,356 tons; Peru 23,686 tons; the Dutch East Indies 12,609 tons; Fiji 8096 tons; and elsewhere.

As will be gathered from the figures quoted above, the Canadian sugar-refining industry has attained a position of considerable importance. The latest accurate information respecting the industry is that just published by the Dominion Bureau of Statistics at Ottawa in connexion with the Census of Industries for 1918, in which year there were in Canada eight sugar refining or manufacturing plants, capitalised in all at $37,256,851, and employing 2542 persons at wages and salaries aggregating $2,626,889. Three of these plants, i.e., those of the Dominion Sugar Company, Limited, at Wallaceburg, Kitchener and Chatham, were in Ontario; there were two in Quebec, namely those of the Canada Sugar Refining Company, Limited, and the St. Lawrence Sugar Refineries, Limited, both at Montreal; and one each in British Columbia (that of the British Columbia Sugar Refining Co., Limited, at Vancouver), New Brunswick (The Atlantic Sugar Refineries, Limited, St. John, N.B.) and Nova Scotia (The Acadia Sugar Refining Co., Limited, Halifax. N.S.). These eight refineries used in their operations materials valued at $45,403,037, classified as under:—

Sugar Beets	204,017 tons, valued at	$2,593,715
Raw Sugar	313,651 tons, ,,	39,991,144
Boneblack, &c.	,,	529,059
Boxes, bags and other containers	,,	2,289,119
		$45,403,037

and the value of products turned our during the year under revision was $58,812,219, made up as follows:—

Kinds of Products.	Unit of Measure.	Quantity.	Selling Value at Works.
Sugar, granulated	long tons	291,045	$57,080,353
Molasses of syrup	gallons	1,559,694	1,016,626
Beet pulp	tons	11,069	411,645
Lime	bushels	22,590	6,250
Fertilizers	tons	1,284	43,075
Cattle food			151,776
All other products			102,494
			$58,812,219

The figures quoted above do not, however, pay any regard to the production and consumption of maple sugar, the making of which is, of course, a peculiarly Canadian industry to which a good deal of attention is now being paid in view not only of the world scarcity of sugar but of the value of the crop to farmers having in their near vicinity a sufficient number of sugar maples. The average farm in the principal centres of the industry contains within its own boundaries from 600 to 1000 and some as many as 4000 maple trees capable of producing sugar. About 16 quarts of sap will make a pound of sugar, and the average yield of sugar is from two to three pounds per tree, there being also valuable by-products in the form of maple vinegar and sugar sand (nitre) which although now generally wasted should be capable of producing a considerable revenue.

The maple sugar industry of Canada is confined to the provinces of Quebec, Ontario, Nova Scotia and New Brunswick; the largest producer, however, is Quebec, the other provinces contributing very small quantities to the total output. The production of maple sugar and syrup increased regularly between 1850 and 1890, averaging between 13,500,000 lbs. and 22,500,000 lbs. during this period. Since the latter year, however, interest in the crop declined until the recent revival of activity in this industry, but the figures for last year which have just been published indicate that the 1919 production of sugar amounted to 5427 tons and of syrup an additional 1,470,775 gallons, valued together at $6,348,605, as compared with 4542 tons of sugar and 1,928,201 gallons of syrup, valued together at $4,418,344, produced in 1918. Several associations have now been formed for the development of the maple sugar industry, which suffered in the past from the low price obtainable for the product and from the increasing value of maple timber, and Government action has been taken to protect the name "maple" from abuse by persons offering for sale articles not the pure product of the maple tree. Everything is being done, in fact, to encourage production, standardize the quality, and to introduce the most modern manufacturing methods. About 60,000 farmers are engaged in the manufacture of maple sugar, and yet it is estimated that at present not one-half of the available sugar maples are made productive, in spite of the fact that the period devoted to the making of sugar on the farm is very short and comes at a season of slackness in other agricultural pursuits. The average price of 29 cents per lb. for sugar and $2·44 per gallon for syrup should, however, be an important incentive to increased production.

Canada and the West Indies.

Details of the Proposed Preference on Sugar and Rum.

The following is the schedule of the proposed Customs Duty of Canada, which was agreed to at the Conference of West Indian and Canadian delegates, held at Ottawa last June:—

The Customs Tariff of Canada shall be amended so as to provide that sugar above number 16 Dutch standard in colour when imported by a recognised sugar refiner, for refining purposes only, upon evidence satisfactory to the Minister of Customs, shall not be subject to these duties—i.e., the duties on sugar over number 16 Dutch standard, specified in item 134 of the Canadian Tariff.

The Canadian Government, failing the adoption of the Polariscope standard for tariff classification, will use its best endeavours to establish a more stable colour standard than the present Dutch standard.

Provided that sugar as defined under item 134 shall receive preference of not less than 25 per cent. of the duty charged on foreign sugar.

Canadian Tariff Item No.	Article.	Degrees of Polarization.				Preference per 100 lbs. Cts.
	Sugar	Not exceeding 76				46·080
135	..	Exceeding	76	and not exceeding	77	47·616
		,,	77	,,	78	59·152
		,,	78	,,	79	50·688
		,,	79	,,	80	52·224
		,,	80	,,	81	53·760
		,,	81	,,	82	55·296
		,,	82	,,	83	56·832
		,,	83	,,	84	58·560
		,,	84	,,	85	60·288
		,,	85	,,	86	62·016
		,,	86	,,	87	63·744
		,,	87	,,	88	65·664
		,,	88	,,	89	67·584
		,,	89	,,	90	69·888
		,,	90	,,	91	72·192
		,,	91	,,	92	74·496
		,,	92	,,	93	76·800
		,,	93	,,	94	79·104
		,,	94	,,	95	81·408
		,,	95	,,	96	83·712
		,,	96	,,	97	86·016
		,,	97	,,	98	88·320
		,,	98	,,	—	96
Rum	..	A preference of 60 cents per gallon of the strength of proof.				

Agricultural Notes.

Millets for Fodder.—Closely connected with tree-planting on sugar estates is the matter of providing plenty of fodder for cattle. The chain of reasoning is a short one. All lands in the tropics, continuously worked, become rapidly poorer in nitrogen, so that, taken as a whole, the cultivated land in warm countries is generally deficient in this respect. It has been repeatedly demonstrated that the sugar cane, in its growth, responds in a remarkable degree to the quantity of nitrogen in the soil. The basal factor in the cultivation on sugar estates is the conservation and increase of this useful element. This may be done both directly and indirectly, but the former is expensive and not altogether satisfactory, while the latter, although it needs careful attention, is cheap and brings in its train all sorts of other advantages; it is therefore by far the more important. We have in the soil a dense population of bacteria doing all manner of things and altering the soil constantly for good or evil: among the rest are such as extract the inert nitrogen from the air and make it available for the growth of plants. It is our duty to increase the action of these to the utmost, and this we can best do by feeding them with vegetable matter, preventing them from drying up and passing into a period of rest, and giving them plenty of air: such treatment, applied to the soil, tallies exactly with what is called "good cultivation" and represents the accumulated experience of the ages, long before there was any knowledge at all of the existence of such things as bacteria. There are various methods by which we can increase the humus in the soil, but by far and away the best is the addition of plenty of cattle manure. Tree-planting helps to add vegetable matter to the soil and, in changing the mineral constituents of the soil to good plant tissue, trees have the advantage over ordinary crops in that they turn to account, by their far deeper roots, less amenable layers of the earth surface: they prevent the soil from drying up, and the bacteria require moisture: they add vegetable mould either by direct shedding of their leaves or bushing the pens or the collection and storing of leaf mould in heaps or pits: lastly, they guard against the washing out of the surface humus, when in an hour's heavy rain the gradual accumulations of a year's bacterial action may be destroyed. But experience gives the palm to the direct application of cattle manure for this work: and it is recognized that this substance will vary enormously in value according to the character of the food given to the cattle. Plenty of fodder of high nutritive value and considerable bulk will aid in yielding a large amount of useful manure: and we would emphasize the point that bulk is important for the purpose in view, namely, that of increasing the humus on which the bacteria feed; and the fibrous character of the fodder also has its influence in this respect.

It is therefore well carefully to examine the sources from which the cattle are fed on each estate. Cane tops are a great stand by in the dry reaping time: are they the best kind of fodder for cattle? Grazing, when obtainable, is obviously of great value, being the natural method of cattle feeding: but are the pastures in the best condition and is there enough good food on them? Scum and waste molasses are excellent for keeping working cattle in full vigour: but is it always added to the cane tops, for these will not of themselves balance the heavy muscular work called for. And so on for the concentrated foods, cakes and patent foods, which, however, are not what we are now considering, for their value is less for the production of bulk of pen manure than for improving the quality of the manure in salts. It is well to make a detailed equation between what is given to the cattle and what is expected from them, for it may be very safely asserted that, wonderful as the internal economy of these useful animals is, they cannot reproduce in an improved form what is not given to them in the crude state. And the sources of fodder during the off season, when tops are not available, is perhaps the point on which intelligent observation should be most concentrated, for this should be the time when the pen manure supply for the year is being built up.

With these facts before us, it may be well to search for some crop or crops which make little demands on the management, whether in requiring good soil, in irrigation during the dry seasons and in labour, and yet will yield quantities of excellent fodder when the prevailing sources are at their lowest. And it is natural to search for such crops in those places where the struggle for existence, for both men and animals is keenest: where the soil has long ago reached the lower limit of permanent fertility (or infertility): where the rains often fail, and where even at the best of times there are long periods of drought every year. In such regions the millets grow and their cultivation in many parts shows a fine example of the victory of man over nature. We are firmly convinced that many of these should find their place on sugar estates, and as most of them are quite unknown in sugar growing countries, we would like to draw attention to some of them, especially from the point of view of fodder production. What, in short, are these millets? Starting with the "Great Millet," the largest of all cereals, known to most of us as Guinea corn or sorghum, we pass through an almost endless series of progressively smaller and less known kinds, till we reach the semi-wild forms, such as are only resorted to in time of famine, and the actual wild grasses which are most closely connected genetically with the millets. And it may be at once remarked that it is not of necessity the largest ones that are likely to prove the most useful for our purpose, for some of the smaller millets possess fodder of considerably greater value although perhaps of less bulk. It is proposed in these *Agricultural Notes* to publish a few details on such of these grasses as may prove of value on sugar estates in improving and supplementing the available sources of cattle fodder, for, let it be carefully noted, they are par excellence the natural fodders of the tropical world, and in nutritive value many of them leave nothing to be desired.

The principal millets are the following :—

(1) *Andropogon Sorghum :* Commonly known as sorghum, Guinea corn, great millet, Kaffir corn, dhurra, cholam, jowar, etc. : the largest millet, growing 5-20 ft. high, according to variety and conditions. With ears varying from close round balls to spreading panicles of the shape and size of an umbrella : grains much larger than the rest, but still only about one eighth of an inch in diameter, and of all colours, from white, through yellow, red and brown, to black. Grown throughout tropical Africa and Asia from time immemorial and introduced into all the warmer parts of the New World. Over 20,000,000 acres of this millet are grown every year in India alone.

(2) *Pennisetum typhoideum :* known as bulrush millet, spiked millet, pearl millet, cumbu, bajra, etc. : a handsome cereal with erect stems 4-6 ft. high and long, cylindrical ears like that of the bulrush. Scattered over the world much as sorghum but to a less extent. Seeds smaller than in sorghum but still larger than those following. Some 15,000,000 acres are grown annually in India and large sections of the population depend on it for their food.

(3) *Setaria italica :* Italian millet, fox-tail millet, Hungarian millet, Boer manna, tenai, korra, etc. : a very pretty plant, 2-3 ft. high, with nodding, rope-like, often bristly ears and small grains like bird seed of a yellowish colour. This millet, as its names indicate, has a much wider north and south distribution than the rest, ranging over China, Japan, India, southern Europe, Africa, Canada and the United States. It is a valuable fodder plant and can be grown on the lightest soils, maturing in a very short space of time.

(4) *Eleusine coracana :* among the host of vernacular names perhaps the most important are ragi and korakan, and it has also been called ginger millet : a valuable millet, usually 1½-2 ft. high, with peculiar ears consisting of a number of branches radiating from the top of the stalk : there are two forms, open and closed, resembling a bird's claw and closed hand respectively. The straw is the most valuable among the millets for fodder and the return of grain is sometimes 500 fold on the seed sown. It is grown as an irrigated crop in South India and is an important article of food, but elsewhere it is rainfed, often in hill tracts like Setaria. There are probably 5-6,000,000 acres in India under this crop.

These four are the chief millets as regards agricultural importance. There are a number of others chiefly belonging to two well known genera of fodder grasses :—*Panicum miliaceum*, *miliare* and *Crus-galli*, with small coarse grains and widely spreading irregularly branched heads, and *Paspalum scrobiculatum* and *Colonom*, all of them bordering on the wild grasses, but by no means of insignificant value from the fodder point of view.

C.A.B.

The Growth of the Sugar Cane.[1]

By C. A. BARBER, C.I.E., Sc.D., F.L.S.

IX. ON TILLERING.

Tillering is the term usually employed to indicate the amount of branching which occurs in a grass during its first, mainly underground, period of growth. On this will depend the number of upright shoots produced during its second, and final, flower producing period. Tillering does not necessarily mean the number of canes maturing at harvest, for, as we shall see, there are a number of factors which limit the plant's power to produce its maximum output: the control of these factors will make all the difference between good and bad planting. Given a piece of land and a certain variety of cane, we can obtain many or few canes, thin or thick ones, according to treatment. Tillering really means the inherent shooting capacity of the cane and this differs a good deal according to the variety and especially the group of cane grown.

Of the characters of a new seedling which we wish to bring into cultivation, tillering is one of the most important, and figures are always recorded of the number of matured canes produced in the first year's growth. But we only get an indication at first, and must grow it for several years before we can be certain that we have got the right figure. Often in the first year a seedling produces a very large number of branches but is disappointing later on, and the reverse may be the case. Of course much depends on treatment. For instance, when the first seedlings were obtained in India, they were treated with the greatest consideration and were planted in large pits filled with prepared earth, as no suitable land was available for planting them out. It is not surprising that some of them produced between one and two hundred well-matured canes. To judge the tillering capacity of a new cane or seedling we must not only approximate as closely as we can to normal field conditions, but also grow at intervals in each plot some of the well-known local varieties with which it is wished to compare it: this has now become the routine practice on the Cane-breeding Station at Coimbatore: and, for fear that the unaccustomed energy of production from fertilized seed may be of influence, we prefer to grow the seedlings for several years under varying conditions before coming to a conclusion.

On examining a batch of seedlings from the same parents, it is at once obvious that they differ in tillering capacity: batches from different parents also vary, as do the parents themselves. We are driven to the conclusion that this is a fundamental character in the variety, just as the thickness, width of leaf, and the many other characters by which we distinguish them from one another. Perhaps the most important point to note, from the crop point of view, is that there seems to be a close relation between the natural thickness of a cane and the number of canes per clump. And, although both of these characters may be profoundly influenced by treatment, for instance by wider spacing, there appears to be an inherent tendency for thinner cane varieties to produce more canes per plant. Thus, thick tropical canes produce fewer branches than thin Indian ones, and the latter vary greatly, not only among themselves individually, but according to the group to which they belong. This is brought out in the figures obtained in the varietal plots at the Coimbatore farm, where the average number of canes per clump was calculated for each of the main groups of canes grown: the following were the averages during one year:—Mungo group (average of 32 varieties), 15·10;

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[1] The previous articles of this Series appeared in our issues of October, November, December, 1919, February, April, June, July, and August, 1920.

Nargori (13), 15·10 ; Brown Saretha (13), 14·00 ; Sunnabile (22), 12·55 ; Pansahi (17), 11·00 ; Green Saretha (10), 9·50. On examining the thickness of the canes in these groups we do not find any correlation between it and the number of canes per clump : thus Mungo and Pansahi are among the thickest, and Nargori and Brown Saretha are among the thinnest. But if we take the varieties in any one group we find some striking figures. The subjoined table is taken from a Memoir[1] by the author where the whole question of tillering is somewhat exhaustively studied. The details were drawn from a comparison of the two groups, Sunnabile and Saretha, and had nothing to do with the subject under discussion when the measurements were taken. The table includes all the varieties in each group which were examined at the time : the plants were grown together in adjacent plots under exactly the same conditions.

SARETHA GROUP

Variety.	Canes per Clump.	Thickness in Cm.
Chin	29	1·5
Saretha (green)	28	1·7
Khari	24	1·8
Hullu Kabbu	22	1·9
Ganda Cheni (poor)	16	2·0
Average	24	1·8

SUNNABILE GROUP

Variety.	Canes per Clump.	Thickness in Cm.
Kaghze	20	1·6
Bansa	18	1·8
Sunnabile	17	1·9
Naanal	15	2·1
Dhor (poor)	12	2·2
Average	16	1·9

From these figures, we see that, in each variety, the tillering power varies more or less inversely with the average thickness of the cane. But another point is also brought out, namely, that for such comparisons we must confine ourselves to members of the same group : the Saretha group, judged by the few examples taken here, has a greater tillering power than the Sunnabile, for while the average numbers of canes per clump are 24 and 16 respectively, the average thickness of the cane is practically the same in the two groups. Saretha canes are usually thinner than those of the Sunnabile group, but independently of this the tillering power is greater. Tillering is one of the most striking characters which, taken as a whole, make up what we call the habit (or appearance) of the plant, and the great groups of sugar canes differ markedly in this respect. Another series of observations made in North India compares the thick tropical canes, the half-thick intermediate forms, and the thin Indian canes, and the relative tillering power of these three groups was as 5 to 7 to 12 respectively : so, while we may accept as a general principle that in cultivated canes thickness and tillering power are inversely related, we must also be careful not to neglect the inherent characters of the groups.

When, however, we come to apply this knowledge, of the tillering power of different varieties of canes, to the number of canes reaped at harvest in the field, we are met with a number of difficulties, and it will be necessary to consider these in some detail. There are a number of factors which limit the power of a cane variety to produce its full quota at crop time. In the first place there are a great many deaths during growth, especially in the stages when canes are beginning to form : then the distance apart of the canes and the general treatment have a very decided influence, and we must find out what are the causes of the influence of these factors and how we may try and control them. Roughly, the chief external influences on the tillering of canes are the light available, the moisture in the soil, the character of the soil, and the amount of manure applied.

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[1] C. A. BARBER, Studies in Indian Sugar Canes, No. 4. Tillering or underground branching. Memoirs of the Agricultural Department in India, Botanical Series, X, 2, 1919.

Of these influences, there appears to be little doubt that light is most important. This is unfortunately the only part of the envisonment over which we have no control: there is so much light available for each square yard of land and we are powerless to increase it: we do not habitually grow canes under the shade of the trees which can be cut down. The physical effect of light upon a grass is to press it down, to check the growth in length of its upright shoots, and thus to divert its energy into branching. Full light thus helps tillering, but, in a closely planted field, once the available light on a given area is filled with cane shoots, all later arrivals are under a disadvantage, lead a struggling existence and often dwindle and die. The same effect is seen in a forest, for on the edges the trees are well-proportioned and spreading while in its depths they are tall, slender, and thin, or if unable to reach the top remain stunted and unhealthy. It is always idle to judge of the number of canes in a field by counting the number of shoots per clump in the outer plants.

Perhaps the deaths taking place in a cane field have received insufficient attention in the past: when all is said and done, they are not good for the plant and use up a great deal of energy which might be more usefully employed. Let us examine some of the figures that have been published. Stubbs in 1894-5 calculated, from a careful examination of the Purple and Striped Louisiana canes, that the deaths among shoots formed 58·9 per cent. of the whole output in 1894, and 56·9 per cent. in 1895. In Java, Muller von Czernicki counted the shoots existing at different periods of growth in several varieties. In Cheribon there were 120-180 in the different plots at 60 days from planting, but only 60-70 after 150 days. In J 247 there were 160-240 shoots at 60 days and 90-100 at 150, while the figures for P.O.J. 100 were 100-170 and 82-86 respectively. Another observer of J 247 found that, while the rows had 300 to 400 shoots (in one case 415) when three months old, at eight months they had only 110. It is obvious that there is far more light during the earlier periods of the cane's growth, and a far greater number of shoots are then encouraged to grow out from the sleeping buds than can be permanently maintained. The air moves freely through the leaves, the soil is adequate and manures and water can be added to meet all requirements: it is light alone which we cannot increase. This heavy mortality has only been fully studied in the thick tropical canes: our observations made for several years at Coimbatore would seem to indicate that there are nothing like so many deaths among the Indian canes during their growth.

Anything tending to the growth of a healthy cane plant has its effect on tillering, a fact which every careful observer has no doubt noted. The amount of air, food, and water available, therefore, has its influence. In a cane field it may often be noticed that particularly large bunches of canes are met with here and there, and many lessons may be learnt from a study of these. Where irrigation is employed, the bunches are usually bigger along the sides of the water channel: and this suggests that the duty of water has not been sufficiently studied. Low-lying places in heavy soil generally produce stunted, unhealthy plants with few branches: aëration of the soil is a limiting factor in the growth of the sugar cane and therefore in its tillering capacity: where irrigation is practised it is especially necessary also to see to the adequate drainage unless this is naturally provided in free self-draining soils. In places where manure heaps have stood, great bunches of cane may be observed and such spots may often be marked from a distance, because the canes are higher and of a darker green. In all of these cases it is seen that a proper treatment of the soil will assist the cane in its tillering power, and he point is here emphasized because one worker in Java (Strüben) has thought fit to construct an elaborate argument to the contrary. Kilian, in Java, has published an interesting paper on the results of his experiments on the influence of various manures on tillering, and has shown that it is greatly increased if suitable manures are employed: of all that he tried the palm is given to well-rotted pen manure. Here we have moisture conserved, the ground aërated, nitrogen-forming bacteria encouraged, and other necessary salts added.

The amount of light present and the quantity of suitable food available are thus of immediate effect on tillering, and the best way in which to regulate all of these is by a proper system of spacing. The accurate placing of the plants in the field is often the key to the whole situation. Spacing experiments have been made wherever the sugar cane has been grown, but too often the results with one variety and soil have been taken as a standard, without proper consideration of the fact that there should be a series of gradations dependent on the individual field and the kind of cane planted. In this matter there is inexhaustible scope for experiment on every plantation, and the maximum output cannot be considered to have been obtained until the matter has been thoroughly threshed out. Let us consider some of the results obtained in these experiments, as a sample of the work to be done. In the Godavari delta, in Madras, where only thick tropical canes can be profitably grown and where immense yields can be obtained, it was the custom to plant the sets at the rate of 25,000 or more to the acre. Tops are not usually available, as these are the perquisite of the owners of the cattle hired for milling, and the cutting up of whole canes is an important item in the farm budget: the cultivator was willing to put by from 30 to 40 rupees per acre for seed cane. One of the first experiments in the Samalkota farm in this area was therefore one on spacing, sets being planted from 4,000 to 30,000 to the acre: the result showed that from 12,000 to 15,000 was ample for the highest yield, with variations according to the kind of cane planted. This single experiment has resulted in the saving of something like 20 rupees per acre. Stubbs, in Louisiana, laid down a series of experiments in 1892-4 in which he planted the sets in 5 ft. rows and 6 ins., 12 ins., and 18 ins. apart in the row. The following table gives his results:—

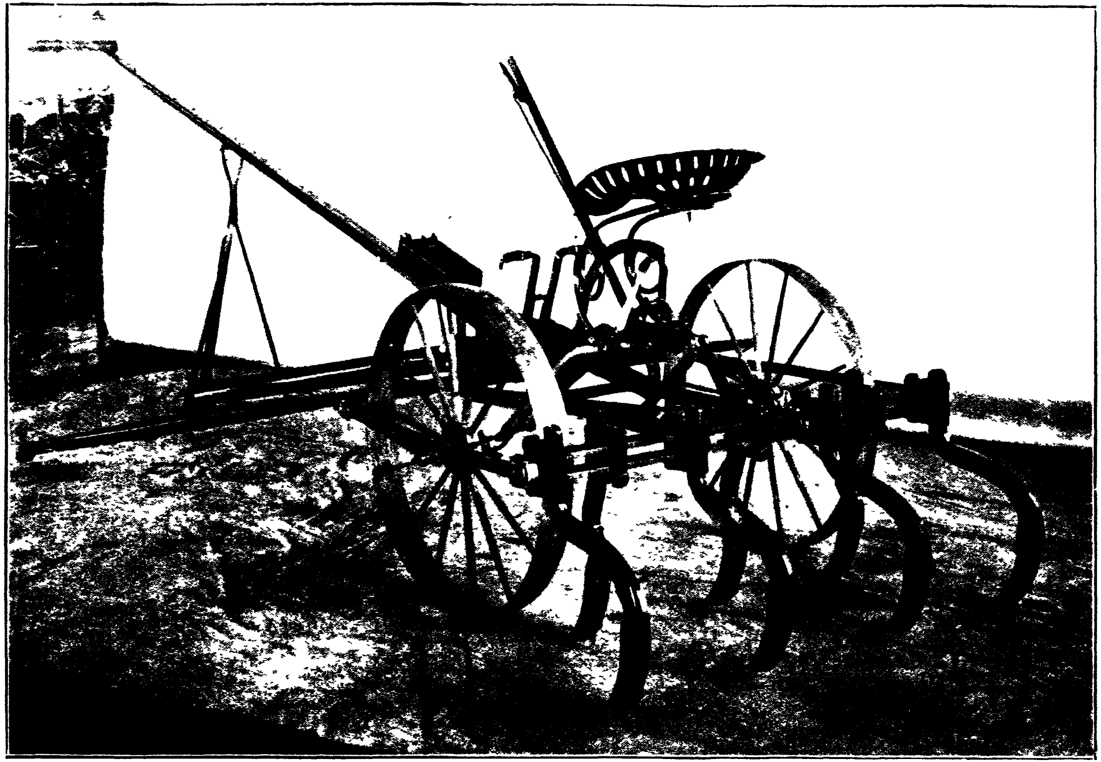
Spacing in the Row.	Number of sets planted (March)	Shoots in June.	Shoots at Harvest (October)	Average weight of each cane.	Tonnage.
6 in.	17,600	72,325	39,050	2·17 lbs.	42·55
12 in.	8,800	51,188	32,964	2·49 lbs.	41·60
13 in.	5,860	37,230	29,070	2·60 lbs.	37·24

The wider spacing produced more shoots per plant and to a greater extent more canes per clump at harvest: there were however fewer canes reaped per acre and, although these were heavier, the tonnage was also less. Where planting material is abundant, close planting would thus appear to be more profitable. But the difference between 6 in. and 12 in. plots is so small that one wonders whether a 9 in. spacing would not quite equal a 6 in. The numbers of deaths shown in the table is arresting, especially in the closer planted rows, but it is difficult to see what can be done to prevent this. In Java where the cost of seed cane is relatively high because of the necessity for nurseries at a considerable distance from the estates, the whole question assumes a different aspect, and the spacing experiments have been conducted in much greater detail, much information having been accumulated as to the tillering power of the different varieties on different fields, but a study of this work would take up too much space in this article. Some details may be found of the Java work in the Memoir quoted above.

Power Cultivation in Argentina.

Some of the Motors with various Implements

Power Cultivation in Argentina.



The Planet No 13 Machine from which was made the furrower or "Middle Buster.

Power Cultivation of Sugar Cane.

By ARTHUR H. ROSENFELD.

In the Report of the Committee on Agricultural Machinery and Implements of the Hawaiian Sugar Planters' Association for the year ended September 30th, 1919, we find the following remarks in a letter to Mr. LIDGATE, the Chairman of the Committee, from Mr. DAVID FORBES, the manager of the Waiakea Mill Co., in regard to the possibilities of motor cultivation of cane:—

"It is the writer's belief that at no distant date tractors will be on the market of a lighter build adapted to such work as cultivation of cane rows and destruction of weeds, or in fact any sort of work where a mule, or mules, can now be used for cane cultivation. It takes no great stretch of imagination to look forward to such machinery and implements of agriculture being used more extensively and propelled by home-made fuel produced from our waste molasses."

The writer of these lines can assure Mr. FORBES that such mental anticipations indeed needed no great stretch of imagination, since, when that letter was written, he had already carried to a successful conclusion the preliminary experiments which led to a complete realization of all of Mr. Forbes' predictions and the adoption of light tractors propelled by alcohol made from our waste molasses in the regular routine of our cultural operations.

The use of heavy and even of light tractors for the preparation of the soil, working of roads, hauling, etc., has been too clearly and definitely demonstrated all over the world to be a success to warrant a discussion in these pages, but the author at least has been unable to encounter records of successful and economical *cultivation* between the cane rows with tractors as the motive force.

Many light tractors have been on the market for years—the Fiat, Fordson, International, Titan, Avery, Cletrac, and Bates among a host of others—but little attention seems to have been given to the development of machinery to be drawn behind the "steel mules" in the actual routine cultivation operations of a canefield.

The writer has had this problem in mind for several years—in fact when the huge plantations of Santa Ana and Lules were entirely renovated in 1916 and 1917 with new varieties of cane under his direction, the rows in the fields were all laid out in as continuous straight lines as possible and the headlands and irrigation and drainage ditches arranged with the view of interfering just as little as possible with long pulls and few turns. Probably few cultivation managers realize the enormous waste of time and the great amount of wear and tear on the machinery incident to the cultivation of short rows even with mules or bulls, and this loss is all the more accentuated in motor cultivation. The object of the writer has been to so design his plantations as to avoid turns more than every half-mile or so, and this arrangement has contributed in no small degree to the financial success of our tractor trials.

The lack of available machinery for sugar cane cultivation with tractors was the most serious drawback to making the trials, which were not begun until we had definitely proved the feasibility of running on alcohol, since the cost of imported motor spirit or kerosene is prohibitive and the use of a combustible made from a waste product of the industry is a decided stimulus to the use of motors in cane cultivation. It may be mentioned here that denatured alcohol, made on the place and denatured under fiscal supervision, costs us about 8d. per gallon placed in the fuel tanks of the motors as compared with about four times that cost for kerosene and more yet for naphtha or gasolene.

All the machinery used had to be made here at the factory or adapted from other tools in use on the place, some of the resultant implements being a combination of three or four distinct tools of various makes. Descriptions of these will be given further on and an idea of the construction of some of them can be obtained from the accompanying Plates.

We selected the Fordson tractor for these trials, and, as a result of these, have definitely adopted it because of its cheapness, lightness, simplicity and ease of securing spare parts—these considerations after the discovery that the motor works perfectly on denatured alcohol, even though the agents themselves were somewhat sceptical on this point when we began the experiments. They feared that the earliness and dryness of the alcohol explosion would cause deterioration in the cylinders, but a year's work under all sorts of conditions has failed to reveal any sign of such an effect in any of the six tractors we have in use at present.

The carburetters of these motors needed no change for alcohol, the motor being started on gasolene and the little pre-heating coil serving to put the alcohol in satisfactory condition for easy explosion in about two or three minutes. Naturally, with alcohol, less carbon is accumulated on the sparking plugs than with kerosene. It is advisable to run the last four or five minutes at night on gasolene, so as not to leave alcohol, which contains water, in the carburetter until work is renewed, as rusting of the preheating coil may be the result.

Breaking Out Middles.—The usual manner of breaking out middles is to run two furrows down the centre with ordinary 8 in. or 9 in. share ploughs. The author's desire was to break out the middles with one operation, and the first trials were made with a 14-in. furrower with a man behind. This immediately proved impracticable, as no man could keep up with the plough all day with the motor developing efficient speed. We then adopted a furrower to a Planet No. 43 cultivator body, and also to the Avery-Magnolia cultivator body, arranging the raising and lowering devices so that they worked satisfactorily with the double mouldboard ploughs, thus converting our furrowers into riding ploughs, until we can obtain a plough coupled direct to the tractor which will need no ploughman for its attention, thus economizing one man's salary on the day's work.

The next difficulty with this implement was that it threw too much dirt to the rows and destroyed traction and depth of entry for the off-barring machine which followed it. This difficulty was finally met by removing the "wings" of the shares, when we found that we obtained just as good work without so much movement of the dirt to the rows.

With the furrower in its present shape, we can break out the middles of about ten acres of cane daily.

Off-Barring.—For this work we utilized and strengthened the Deére discbedder, as shown in the illustrations. This work is usually accomplished by running a furrow close up to each side of the row with a share plough, but with this machine we do the work far better in one operation. This is really the prettiest work we have done with the tractors, the photograph evidencing its efficiency. The rows are smoothly and deeply off-barred, any projecting stubble cleanly pruned off and the dirt beautifully pulverized and thrown well to the centres, leaving ideal conditions for the stubble shaver, which requires neat off-barring and the dirt well thrown away from the rows for full efficiency.

With this off-barring machine we cover eleven to twelve acres daily.

Shaving and digging stubble.—For this work we combined the Avery stubble shaver and the stubble digger into one machine by taking off one pair of wheels of the shaver and connecting the two by a rigid plate. This is the quickest work

Power Cultivation in Argentina.

ON LEFT

Off-barring Cane with a Tractor

ON RIGHT

Cane off-barred with Tractors. These Machines worked a Half-Mile without turning

Power Cultivation in Argentina.

The Disc Bedder arranged for off-barring with Tractors

Cutting and shaving Stubble at one Operation.

which we do with the tractors and it saves the expensive spade or hoe work of knocking the dirt off and from around the stools and returning the same dirt afterwards. It leaves the stools cut cleanly off and well down into healthy cane, lowers the rows for easier irrigation and subsequent cultivation and leaves an ideally soft mulch over the tops of the stubbles, conducive to quick and easy germination. The whole secret of success with this machine, which so many people seem to have ignored, is the keeping of the horizontal discs well sharpened and properly adjusted. We send a Little Luther grinder into the field with each machine and the discs can thus be easily and quickly removed and filed in about ten minutes after about each two acres of work. By having extra discs with each machine, the only time lost is that required to unscrew and screw up again a couple of nuts for removing and replacing the discs, the discs taken out being sharpened by a boy while the machine is running, or after working hours at midday and evening by the tractor operator himself, for a few cents per disc.

With this machine fifteen acres of cane can be covered in a day, with rows at 6 ft. 6in., as we have them here at Tucumán for the rapidly suckering Java canes. Naturally with 5 ft. rows, such as are commonly employed in Louisiana, Hawaii and many other countries, a proportionately smaller acreage must be calculated.

Miscellaneous work.—We have used the tractors, also, for throwing dirt to the cane by running the disc bedders down the centres, and for weeding by pulling a pair of reversible disc harrows, parallel and in two middles when the cane is still low enough for the motor to straddle the row, and tandem and in one middle at a later time. For pulling ordinary road machines of the "Champion" type, they serve admirably, as well as for large plank drags, clod-breaking rollers, smoothing rollers and the like. In the coming cultivation season we expect to try them out for other operations of later cultivation.

Running expenses.—We have found it the best policy to have one good man in charge of all the motors and give him good transportation facilities such as a motor cycle or light motor car, thus enabling him, even on a very large place, to see all of the machines several times per day. The driving can then be done by boys quickly broken into the work. These can start the motors and manage them, change sparking plugs, tremblers, etc., and see to the requisite supplies of water, oil, gasolene for starting and finishing, and alcohol, but any major trouble must await the coming of the man in charge. Such boys can be selected on any plantation from the brightest, more ambitious workers, and their salaries need be but little higher than the ordinary ploughman's. Almost any boy would prefer to sit and drive a motor than to walk behind a pair of mules or bullocks.

Prices of materials vary so much in distinct countries that the author will not here attempt to calculate the cost of the work, which can easily be done by anyone interested by inserting the cost of alcohol, lubricating oil, etc., in his particular locality in the following table of daily consumption per tractor. These figures are for a day of eight hours' actual work, and include allowances for going to and coming from work at an average distance of three-quarters of a mile from where the motors are kept, the estimated quantities of materials used being, therefore, well on the liberal side. The amount of work done will be found under each operation already discussed—in number of acres covered per day.

DAILY FUEL AND OIL CONSUMPTION.

Denatured alcohol	80 litres.	Cylinder oil	4 litres.
Gasolene or naptha	0·5 ,,	Marine oil	0·1 ,,

The Sugar Conditions of the Philippines.

BY GEORGE H. FAIRCHILD.[1]

According to authoritative records sugar was exported from the Philippines to the United States as early as 1795, United States statistics for that year showing that some 132 long tons of Philippine sugar were imported.

Some of the cultivated varieties of sugar cane in the Philippine Islands are presumed to have been introduced from China, and it is possible that others are indigenous to the Islands. The methods adopted in the native mills for the manufacture of muscovado sugar also came from China.

Up to the middle of the nineteenth century the production of sugar cane was confined largely to the provinces in Luzon near Manila, but following an increased demand from Europe for sugar during the Crimean War, interest in the industry was greatly stimulated and its development was extended into the Visayas, and Occidental Negros became the largest cane-producing sector in the Philippines. From that time to about the end of the Spanish Administration, the industry showed a steady development, the banner year being 1893, when approximately 300,000 tons of sugar were exported.

All this sugar was what is known as muscovado sugar, this being the quality of cane sugar in general production throughout the world at that time. Toward the end of the nineteenth century, however, refiners began to insist upon a higher quality of raw sugar from cane than muscovados. This was occasioned by the development to a high degree of the beet sugar industry in Europe and the fact that beet sugar could be turned out in refined form. Other cane-producing countries met the refiners' demand by the erection of more up-to-date mills, but the Philippine Islands, for reasons that will be given, continued until within the past ten years to use their native mills. Even now the bulk of the Philippine crop consists of muscovado sugars, as is evidenced by the estimate of the crop now being harvested—225,000 tons of sugar, consisting of 150,000 tons muscovados and 75,000 tons centrifugals. But the advantages of modern sugar centrals have now been brought home to the planters. There are at present twenty centrals in operation and eight under construction or planned for immediate development, and it will not be long before the ratio of centrifugals to muscovados is reversed.

The political situation of the country toward the end of the nineteenth century undoubtedly retarded the development of the sugar industry. During that period there was much political unrest, which culminated in the insurrection against Spanish sovereignty; later the American occupation of the Islands was followed by a period of disturbances until law and order was finally established. And, as if political troubles were not enough, there came an epidemic of rinderpest, which is said to have destroyed 80 per cent. of the work animals in the Islands. In view of the political uncertainties of the time, it is not surprising that there was no influx of much needed capital to modernize and develop the sugar industry in keeping with the development that took place in other cane-producing countries; and following such a calamity as the rinderpest epidemic one is not surprised to find production considerably reduced. During the first ten years of American occupation, as a result of these unfavourable conditions, the exports of sugar from the Philippines averaged only about one-half what they were during the last ten years of Spanish occupation. However, the passage of the Payne-Aldrich Bill in 1909, providing for free entry into the United States markets of up to 300,000 tons of Philippine sugars, and, a little later, the introduction of modern sugar centrals in the industry stimulated the production, which increased considerably, so much so that the year 1916 showed exports of sugar amounting to about 375,000 tons of 2000 lbs., the largest in the history of the sugar industry of the Philippines. This showing was mostly due to an exceptionally favourable growing and harvesting season. Since that time production has decreased about 40 per cent., due partly to unfavourable weather conditions, but to a greater extent to adverse shipping conditions arising out of the scarcity of tonnage occasioned by the war and the high freight rates for such tonnage as was available. The lack of tonnage and high freight rates prevented sugar from reaching the United States and European markets, and stocks accumulated to such an extent that the situation became critical; until, through the efforts of the Philippine Government in Washington, arrangements were made to ship a large quantity of the accumulated stocks to the United States.

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[1] Abridged from an article in the *Yearbook of the Philippine Islands, 1920.* (Published by the Chamber of Commerce of the Philippine Islands, Manila.)

With the termination of the European War the sugar industry of the Philippines passed rapidly from its critical stage into one of unprecedented prosperity. Large purchases of Java sugar by European countries in the beginning of 1919 left China and Japan looking around for sugar to meet their requirements, and naturally their attentions turned to the Philippines. Then began the era of high prices, unprecedented in the history of the sugar industry in the Philippines. Prices rose steadily from 7 pesos per picul for No. 1 sugars in the beginning of the year to 30 pesos per picul by the middle of the year, and centrifugals advanced in the same period from 11 pesos per picul to 34 pesos. The coming year will be even more prosperous than the previous year; prices at present are not much below the maximum prices for the previous year, and the average price at which the present crop sugars will be sold will be considerably in excess of the average price for the last crop, for high prices have ruled since the beginning of this season's market, while only a part of last season's crop was sold at the maximum price. Besides, by the time the high prices came last year, most of the sugar had passed from the hands of producers into the hands of dealers; but this year the producers will get the full benefit of the high prices; and, if the out-turn of the crop is satisfactory, this should enable them to increase materially their planting for the next crop.

The serious shortage of sugar which has followed the cessation of hostilities in the European war and which still continues offers an opportunity for Philippine cane producers to exert themselves, and I shall touch briefly on what, in my opinion, are the best means to increase production in these Islands. This will mean comparing conditions here with those in other cane-producing countries. Comparisons are generally considered odious, but they are permissible when instructive.

Possibly the Philippines could find its best lesson in increasing its sugar production from Japan's policy in rehabilitating and developing the sugar industry in Formosa. When Japan acquired Formosa in 1894-95 as a result of the Chino-Japanese War, the opportunity was made available to her to solve an economic problem which had been causing her considerable anxiety—namely, to provide some means within her own territory of meeting the continually increasing demand for sugar. The consumption of sugar in Japan at that time amounted to 300,000 tons, of which Japan produced only 65,000 tons, leaving 235,000 tons to be imported. Japan lost no time in taking advantage of this opportunity, and the fact that production in Formosa has been increased so tremendously is generally admitted to be due to the encouragement received from the Government. When Japan took over Formosa, the production had fallen to 30,000 tons, but by a systematic study of conditions, carried out under the direction of the Government, production has gone up to as high as 440,000 tons (in 1917).

The local Government would be doing no more than its duty by rendering to the local sugar industry the same assistance that Japan rendered to the industry in Formosa, for most of the problems that required solving in Formosa exist now in the Philippines. The Japanese Government sent experts to make a close study of the industry to determine the best means to adopt for the improvement of the methods used both in the cultivation and in the manufacture of the product. The first result of this investigation was the importation of some of the Hawaiian varieties of cane, and it is stated that the prosperity of the Formosan sugar industry dates from this. In 1901 the Japanese Government sent Dr. NITOBE, chief of the Industries Bureau, to Formosa, requesting him to make a thorough investigation of the sugar possibilities of the entire island. In his report he outlined a comprehensive plan to be carried out during a ten-year period. The following recommendations made by him are so applicable to the sugar industry in the Philippines that they compel publication:

1. Improvement of cane by importation of better varieties from other sugar-producing countries.
2. Introduction of a more intensive method of cultivation.
3. Establishment of a model farm to demonstrate to the farmers the advantages of improved methods.
4. Increase the yield by use of artificial irrigation.
5. Improvement of manufacturing methods by the introduction of modern sugar machinery.
6. Make provision to train experts in all branches of the industry.

The Japanese Government proceeded to develop the industry along the lines recommended by Dr. NITOBE, and the results exceeded expectations. During a ten-year period prescribed by him, the acreage under cane had increased from 65,000 to 225,000 acres, and the total quantity of sugar produced had increased from 50,000 to over 300,000 tons. The Government also granted bounties to planters for the specific purpose of meeting expenses involved in purchasing fertilizers and modern machinery, in reclaiming and draining land, and in making improvements. The adoption of improved methods of cultivation has increased the yield of cane from 10 tons to 15 tons per acre and in many instances to 20 tons; or, in other words the yield of sugar has increased from 1 to 1·5 tons per acre with good prospects that it will soon reach 2 tons, according to statistics contained in the Government records. It is interesting to note in passing that the bulk of the Formosan cane crops are produced by Chinese. During the past nine years the yield of sugar in the Philippines has averaged only three-quarters of a ton per acre—less than half the yield obtained in Formosa, and comparing even more unfavourably with the largecane-producing countries of the world.

When we view the tremendous development the co-operation of the Japanese Government with private enterprise has made in the Formosan sugar industry, during the past twenty years, and reflect that at the end of the same period production in the Philippines is practically the same as it was at the beginning, we are led to hope that the local Government will afford private enterprise whatever assistance is required to increase production in the Philippines.

In view of the importance of the sugar industry in the economic welfare of the country and the excellent prospects in the world's market for sugar, the time is opportune for the Government to adopt a policy of encouragement and assistance to sugar producers similar to that of Japan in Formosa. In time the Orient will look to the Philippines for part of the sugar to meet their increasing requirements. Japan's need of rice has resulted in the restriction of the area planted to cane in Formosa, and therefore the Formosan sugar crop is not likely to exceed 300,000 tons in the future. The consumption of sugar in Japan has now reached 500,000 tons, and it is evident therefore that Japan will be a large importer of raw sugar. It is also possible that the same need of rice will prevent Java from being able materially to increase her sugar production. The Philippines have sufficient land available to produce more rice than they need and to double within a short time their present production of sugar without materially increasing the areas now under cultivation to cane.

It is interesting to note that Cuba, which already employs 40,000 Chinese labourers, in order to safeguard its present sugar production and if possible to increase it, is going to increase this number to 100,000 within the next two years. In Hawaii 50,000 field labourers are required to produce the annual crop of from 500,000 to 600,000 tons of sugar, but soil and climatic conditions in Cuba are such that the same amount of labour in Cuba could possibly produce three times more sugar than it could in Hawaii. Therefore, 100,000 Chinese in Cuba should be able to produce from 2,000,000 to 3,000,000 tons of sugar annually.

The introduction of 50,000 Chinese into the sugar industry in the Philippines and the application of more intensive methods of agriculture that are not possible under existing conditions, would double the present sugar production from the area at present under cultivation for cane.

The Paper Making Qualities of Hawaiian Bagasse.[1]

By ARTHUR D. LITTLE, Inc.

(Continued from Page 460.)

COMMERCIAL ASPECT OF PAPER MAKING POSSIBILITIES.

Fuel value of bagasse.—NORRIS obtained an average value of 8100 B.T.U. for Hawaiian bagasse; and on the four samples of Hawaiian bagasse which we received the thermal values were found to be :—

SAMPLE.	MOISTURE.	B.T.U (as received.)	B.T.U. (dry basis.)
Yellow Caledonia, Lot 1.	5·83	7659	8133
„ „ Lot 2.	7·56	7566	8185
Hawaii 109	6·04	7684	8178
Lahaina	7·04	7563	8135

Taking an average of 45 per cent. of water, NORRIS calculates that a typical Hawaiian bagasse would have an effective heating value of 2909 B.T.U. per lb. of green bagasse, a considerably lower figure than that found for Cuban bagasse by MEYERS, viz., 3848 for 47 per cent., of water.

Californian fuel oil may be taken at 18,700 B.T.U., and the calculation of the relative value of bagasse and oil would be: Bagasse with 45 per cent. moisture should give 2909 B.T.U.; boiler efficiency, 55 per cent.; effective B.T.U., from wet bagasse, 1600 B.T.U.; fuel oil, 18,700 B.T.U.; boiler efficiency, 70 per cent.; effective B.T.U. from fuel oil, 13,090 B.T.U.; cost of California fuel oil, $1·20 per barrel of 330 lbs., or $7·27 per ton. Then 1600/13,090 × 7·27 = $0·89 per ton of wet bagasse. The value of 1 ton of green bagasse will be assumed as $1·20 per ton, a figure considerably in excess of the calculated value. It should be conservative for the period immediately before the war.

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[1] Extracted from the Report of the Experiment Station of the Hawaiian Sugar Planters' Association; Bulletin No. 46, Agricultural and Chemical Series, Honolulu, T.H., 1919.

Cost of bagasse and poplar pulps.—Poplar wood cost $7·50 (pre-war figure) per cord, and as one cord yields approximately 1000 lbs. of bleached pulp, the cost of the raw material for 1 ton of the bleached pulp would be $15·00. In the case of bagasse a yield of 30 per cent. of bleached pulp should be obtained, and from this it may be calculated that the cost of the bagasse necessary for 1 ton of bleached pulp is $4·85, assuming that the bagasse would be sifted, and the pith used as fuel.

This comparison shows that bagasse even with a definite value has a tremendous advantage over pulp wood. Moreover, the value of pulp wood has increased over 100 per cent. in the past few years, and there is no reason to believe that the price will drop materially, since the supply is constantly diminishing.

Pulp or finished paper.—Either the bagasse could be converted into bleached pulp for sale on the mainland, or it could be entirely made into paper. In favour of the pulp proposition is the lower investment, besides which conversion into paper requires skilled labour, cheap fuel, and cheap supplies. On the other hand, in the marketing of the pulp as such, difficulties would be encountered more than offsetting the advantages mentioned. There is practically no market for soda pulp in the U.S. west of the Mississippi River under normal conditions; but there is a market in the Coast States for book and other papers. From enquiries which we have made it would seem quite possible to dispose of a fair tonnage of paper in the Western United States, whereas it would be practically impossible to market the pulp. As to the conditions applying to the Far East and Australia, we are not well informed of these. Hawaiian bagasse would offer distinctly better possibilities if converted into paper rather than pulp, which may be termed an intermediate product. There would be the possibility of varying within limits the nature of the product, and bagasse is especially well adapted for use as a book paper, and an excellent grade of cheap writing paper could also be made.

Size and location of mill.—The shrinkage incidental to making pulp would be far greater than the difference occasioned by cheaper chemicals and supplies on the Mainland. With a full understanding of the difficulties involved in bagasse supply, and the extent of the investment required, we do not believe it advisable to consider less than an output of 30 tons per day, operating on a 300 day per year basis.

The most important essential features of the location of any pulp mill are: water supply, bagasse supply, shipping facilities, drainage, and relation of pulp mill to surrounding community.

In regard to water, in the case of a mill to turn out bleached pulp from Hawaiian bagasse, we believe that it would scarcely be safe to figure on less than 50,000 gallons per ton of pulp, exclusive of that required for the steam plant. It should be a soft or, at the worst, a medium hard water. Calcium and magnesium salts are prejudicial in the sizing process, and absence of organic matter is also important.

The bagasse supply must be available to the pulp mill at the lowest possible expense for transportation and handling. Approximately three tons of air-dry bagasse will be required to produce one ton of air-dry bleached pulp, although a part of these three tons would be returned to the boilers as fuel. The actual consumption of green bagasse for making one ton of dry pulp would be about four tons. It is, therefore, important that location should be most carefully considered in order to draw this amount daily from one or more mills.

Regarding shipping facilities, there would be a certain amount of incoming freight in the form of raw supplies, as chemicals, and possibly mixing fibres, as sulphite pulp. As to drainage, the disposal of the waste water should be so arranged as to avoid any danger of polluting potable water supplies in the neighbourhood. Lastly, relative to the surrounding community, the question of odour in the case of a sulphate mill would have to receive careful attention.[1] Even under the most carefully regulated conditions, it may at times be bad; but proper design and care in operation should reduce the causes of complaint from this source to a minimum.

ESTIMATES OF INVESTMENT AND PRODUCTION COSTS.

Under the conditions prevailing when this Report was written (1918-9), it is difficult to make estimates. Present labour, fuel, material and transportation costs are to a great extent fictitious. In most cases they will be lower after the War, even though they do not revert to their pre-war level. We have concluded to base our estimates on pre-war conditions.

Estimated cost of bleached bagasse pulp, 30-ton soda mill, 300-day year (based on conditions prevailing in 1912):—

			Per Ton of Bleached Pulp.
Item (1)	Raw bagasse		$4·85
,, (2)	Other materials, wires, felts, etc.		1·25
,, (3)	Chemicals:		
	Lime, 897 lbs.	$3·14	
	Soda Ash, 277 lbs.	3·74	
	Bleaching Powder, 330 lbs.	5·76	
			12·64
,, (4)	Heat and power		7·27
,, (5)	Repairs (material and labour)		1·70
,, (6)	General labour		6·00
,, (7)	Taxes, Insurance, Administration		1·67
,, (8)	Depreciation		1·00
,, (9)	Selling expense		0·90
	Total Cost F.O.B. Mill		$37·31
,, (10)	Delivery		10·00
	Total Cost delivered		$47·31
,, (11)	Selling Price delivered		55·00
,, (12)	Profit per ton		7·69
	,, ,, year		69,210·00

Percentage return on total investment .. $\frac{\$69,210\cdot00}{\$350,000\cdot00}$ or 19·6 per cent.

Percentage return after deducting interest at 6 per cent. 13·6 ,,

Notes on estimates.—The price of the raw green bagasse is assumed to be $1·20 per ton, containing 45 per cent. of moisture and 55 per cent. of fibre, and to yield 45 per cent. of bleached pulp on the dry sifted bagasse. Pith and fibre are assumed to have equal value as fuel. Item 2 includes oils, felts, wires, screen plates, belting, water and miscellaneous. In regard to item 3, the bagasse would be cooked with 25 per cent. caustic soda on the dry sifted fibre. A recovery of 75 per cent. of the alkali is assumed. Lime equivalent to the total soda ash recovered would be required, and it would be burnt locally for $7·00 per ton. A value of $27 per ton is taken for the soda ash c.i.f. Honolulu. Bleaching powder equivalent to 16·5 per cent. of the bleached pulp at $35·00 per ton, Honolulu, would be required. The total amount of fuel would be slightly less than one ton of oil per ton of pulp at $1·20 per barrel of 330 lbs. Referring to item 7, this would consist of taxes and insurance, 2 per cent. on $300,000 (for a yearly output of 9000 tons); superintendent, $3,600; assistant, $2,400; and laboratory and office, $3,000. Depreciation is taken as 3 per cent. on $300,000. It would cost $20·00 to deliver pulp in New York; but only $8·06 in San Francisco. In 1912 soda pulp sold for about $44·00 per ton delivered, but bagasse pulp would be somewhat better than this material. $55 is a conservative selling price. A 30-ton pulp mill for bleached pulp would have required about $240,000 in 1912 for buildings and equipment and about $60,000 for a power plant. This has been increased to cover the higher cost of freight. In addition to capital required for equipment and buildings, about $50,000 would be necessary for working capital, making a total capitalization of $350,000.

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[1] See *I.S.J.*, 1920, 456.

Estimated cost of bagasse book paper, 30-ton mill, 300-day year (based on conditions prevailing in 1912).

	Cost Per Ton.
Cost of dry bleached pulp at mill	$37·31
Credits for part of pulp making process	1·90
Cost of pulp in paper machine chest, including pulp mill overhead	$35·41
1800 lbs. pulp at $35·41 per ton	31·86
630 lbs. clay at $24 00 per ton	7·56
Conversion expense, including fuel, power, labour, and supplies	16·38
Total manufacturing cost, F.O.B. mill	$55·80
Selling, Administration, Taxes, Insurance	3·33
Delivery	10·00
Total cost, delivered	$69·13
Earnings:—	
Value of Product	$90·00
Cost of Product	69·13
Profit per ton	$20·87
Profit per year	$187,830·00
Percentage return on total investment	31·3 per cent.
Percentage return after deducting interest at 6 per cent.	25·3 ,,

Total investment (pulp and paper mill):—	
Pulp mill	$240,000
Paper mill	210,000
Power plant	100,000
Working capital	50,000
	$600,000

Summary of Estimates.—Based on conditions prevailing in the Eastern United States in 1912, an investment in a 30-ton pulp and paper mill of $600,000 should show a net yield of 25·3 per cent. after deducting interest charges on the capital. Provided a supply of bagasse could be assured which would be available for 300 days, a project of such dimensions should receive consideration. If a pulp and paper mill of such an output appears impracticable, a smaller unit with a capacity of 10 tons per day and a capital investment of $225,000 might be expected to show a net return of 15·6 in normal times, but a mill of this capacity would be small compared with mainland mills with a comparatively less profit. A small mill would, however, require less capital, and might be considered a better initial proposition. If favourably considered, it should be designed to take care of a future expansion of at least 100 per cent.

(Concluded.)

The Double Polarization Method for the Determination of Sucrose.[1]

By RICHARD F. JACKSON and CLARA L. GILLIS.

INTRODUCTORY.

General.—It was the purpose of this research to examine sources of error, and to enquire which could be eliminated, in the hope that the method of acid inversion might be made to approach that of the invertase inversion in respect of accuracy and reliability.

Of the various modifications of Clerget's original method[2] the one most widely used is that of HERZFELD.[3] He established 142·66 as the constant, a value which, though frequently found too low, is still in general use. At the New York meeting of the International Commission for Uniform Methods of Sugar Analysis, held in 1912,[4] HERZFELD requested that this value should be re-tested. Variations of Herzfeld's method have been proposed by STEUERWALD,[5] BROWNE,[6] WALKER,[7] and others.[8]

PRELIMINARY EXPERIMENTS.

Velocity of inversion of sucrose.—This was measured by the authors at temperatures from 20 to 90°, and found to follow the exponential law first proposed by ARRHENIUS. Rates of reaction were measured for three different concentrations of hydrochloric acid, viz., 0·01, 0·1, and 0·7925 N; and the time required under different conditions to produce 99·99 per cent. inversion was computed and tabulated.[9]

Approach to complete inversion.—Since the various methods of acid inversion that have been proposed are carried out under quite dissimilar conditions, experiments were performed to observe the velocity of the reaction in each, and the time required for its completion. In every case 10 c.c. of 6·4 N hydrochloric acid (equal to 5 c.c. of 38·8 per cent. acid) were used, and inversion was abruptly stopped at the expiration of definite periods of time by the addition of sodium hydroxide solution, after which the solution was cooled, made to volume at 20° C., and polarized at the same temperature. Since in these tests the exact rotation of the solutions was not of interest, but merely the time necessary to complete the reaction, the maximum rotation in each series (except that in which Browne's modification was used) was multiplied for ready comparison by such a factor as to make it equal to — 34·02,[10] all other rotations of the series being multiplied by the same factor. Curves were plotted to show the relationship in the time required to effect inversion by the different procedures.

Curve 1 shows the rate at which a sugar solution approaches complete inversion when maintained at 60° throughout the whole course of reaction. The data were obtained by computing the value of R_t in the equation:

$$k = \frac{1}{t} \ln \frac{R_0 - R_\infty}{R_t - R_\infty}$$

at various intervals of time when $k = 0{\cdot}4606$, inversion being calculated to be 99·99 per cent. complete in 8⅓ minutes.

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[1] Editorial Summary of *Scientific Paper, No. 375, Bureau of Standards, Washington, D.C., U.S.A.* (This Bulletin is obtainable of the Superintendent of Documents, Government Printing Office, Washington, D.C., U.S.A.; price 10 cents.)—An abstract of this important research has already been given, for which see *I.S.J.*, 1920, 175.

[2] *Ann. Chim. Physic.*, 1849, 26, 175.

[3] *Zeitsch. Ver. deut. Zuckerind.*, 1888, 38, 699.

[4] *I.S.J.*, 1912, 574–581.

[5] *I.S.J.*, 1913, 489.

[6] *I.S.J.*, 1917, 139.

[7] *I.S.J.*, 1917, 31; 1918, 239; 1919, 304.

[8] *I.S.J.*, 1912, 629; 1914, 39; 1915, 179.

[9] For these data reference must be made to the original paper.

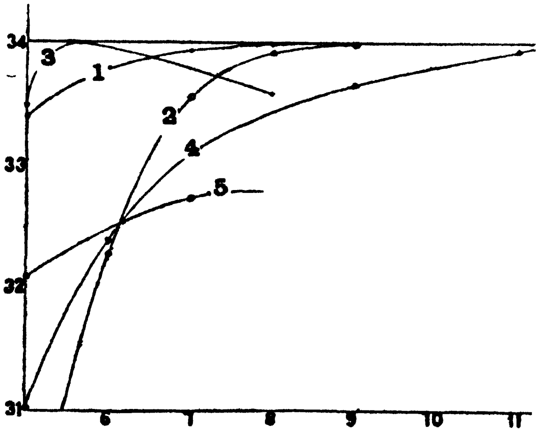
[10] That is twice the negative rotation of a ½N solution of sucrose when inverted by 10 c.c. of 6·4 N acid, and neutralized with sodium hydroxide.

Curve 2 shows the progress of the reaction when acidifying at room temperature and placing in the water-bath at 60° C. The reaction, using 15·6 grms. of sucrose in 70 c.c. of water in a 100 c.c. flask, should be complete in 9 minutes.

Curve 3 shows the time required for complete inversion, in accordance with Herzfeld's method, using 50 c.c. of a normal solution diluted to 70 c.c. in 100 c.c. flasks. Heating was such that the contents of the flasks reached 69°C. in 4½ mins., and remained within 0·2°C. during the 5-minute period following, while shaking frequently. The maximum value was reached in 5½ mins. in this way; but on continued heating the polarization decreased quite noticeably, because of the decomposition of invert sugar. In Herzfeld's method, the shortest time that the solutions may be heated while adhering to the conditions specified is 7 minutes, but in practice it is frequently as much as 10.

Curve 4 demonstrates the reaction when following Walker's method, using 50 c.c. portions of a normal solution diluted to 70 c.c. in 100 c.c. flasks. These liquids were heated to 65°C., removed from the water bath, acidified, and allowed to stand for definite periods. It was found that the reaction is practically complete in 12 mins. WALKER prescribed 15, and he found no change of rotation after 30 mins.

Curve 5 relates to Brown's modification, in which 50 c.c. of a normal solution plus 5 c.c. of acid is allowed to stand overnight in a 50- 55 c.c. flask at room temperature. If, however, the inversion is carried out at 60°C., using the half-normal weight in 40 c.c. and 10 c.c. of 6·40 N acid, the time required is 7½ to 8 mins. In these tests the polarization of the solution completed to 55 c.c. was multiplied by 11/10.



Decomposition of invert sugar.—In order to ascertain the effect of an excessive time of heating, or, in other words, the rate of decomposition of invert sugar in the presence of hydrochloric acid, over a certain range of temperature, the following experiments were made: 50 c.c. of 0·7925 N hydrochloric acid[1] were added to 250 c.c. of a solution containing the half-normal weight of sugar in 70 c.c., which liquid was placed in a thermostat set at different temperatures, viz., 50, 60, 70 and 80°C. When inversion was complete, and at various later intervals of time, a sample sufficient to fill a polariscope tube was transferred to a small flask which was immersed in ice water and carefully corked. The polarization of these solutions was multiplied by such factors as to make the rotation of the first sample (that in which inversion was just complete) equal to—33·25, that is twice the reading of a half-normal solution when completely inverted. The rate of decomposition was calculated for each temperature, and the values are thus summarized :—

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[1] That is, the acidity caused by 5 c.c. of 38·8 per cent. HCl in 80 c.c. of water.

Temperature, degrees C.	Decrease, per minute.
80	0·1670
70	0·0560
60	0·0132
50	0·0034

This table shows the great advantage of performing the Clerget analysis at temperatures lower than 70°C. Not only can the time be regulated with greater precision when the reaction is slower, but the decomposition resulting from an error in timing is less than one-fourth as great at 60°, and but one-sixteenth as great at 50°C. The time of heating at 60° can be varied between 8 and 11 mins. and practically the same result obtained. According to Curve 3, illustrating the course of the HERZFELD inversion, there are five minutes during which decomposition is occurring, and the invert polarization may under these conditions be nearly 0·3 too low.

APPARATUS AND MATERIALS.

Saccharimeters.—The saccharimeters used, and the many precautions taken to utilize their full sensibility, have been previously described in a publication by BATES AND JACKSON.[1] In brief, the instruments were the most recent type of FRIC saccharimeter equipped with Bates' device for adjusting the sensibility, a Julius Peter saccharimeter, and to a small extent a Schmidt and Haensch saccharimeter, but the Bates-Fric apparatus was the main reliance. BATES AND JACKSON found that under the most favourable conditions the precision with which a measurement could be made with a saccharimeter approached very closely that attainable with a very sensitive circular scale polarimeter illuminated with monochromatic light. The means of their measurements is probably accurate to 0·01° S.

Temperature control.—A measurement valid to 0·01° S. must be controlled to 0·02° C. Therefore all measurements were made in a thermostatted dark room. The saccharimeters were completely enclosed in a small wooden air-bath, equipped with an electrically operated thermostat, securing a regulation of temperature somewhat closer than 0·1° C. Further, a stream of water was sent through the water-jacket of the polariscope tubes, by a small centrifugal pump, this water being taken from a thermostat constant to 0·01° C. and led through vacuum-jacketed glass ducts, surrounded by 3 ins. of powdered cork. The polariscope tubes were provided with a supplementary jacket, which completely surrounded all the exposed portions of the tubulature and the lower portion of the thermometer, leaving only a small hole through which the bulb was passed.

Quartz control plates.—The rotation of the negatively rotating quartz plates had been measured by the Physikalisch-Technische Reichsanstalt in terms of wave length 5892·5 A, and by the Bureau of Standards in terms of wave lengths 5892·5 A and 5461 A. To convert these values into sugar degrees, the former were divided by the factor 34·620 and the latter by 40·690 in accordance with the measurements made by BATES AND JACKSON. The three independent sets of calibrations were in excellent agreement.

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[1] Bulletin 13 (Scientific Paper 268) of the Bureau of Standards.

Materials.—The sucrose was prepared by crystallizing from aqueous solution in the manner described by Bates and Jackson.[1] The invert sugar was prepared by inverting sucrose at 55° C. with invertase extracted from bottom yeast, the enzyme finally being destroyed by heating to 70-80° C. for about one hour.

In regard to the hydrochloric acid, Herzfeld precribed 38·0, and the Association of Official Agricultural Chemists 38·8 per cent. The authors have found it more accurate and convenient to dilute the concentrated acid to exactly half the concentration specified by the A.O.A.C., since the varations in the strength of the commercial acid (which are sometimes rather considerable) can be readily corrected. The dilute solution does not vary in strength by loss of acid, as it has approximately the concentration of a constant boiling mixture; the discomfort of pipetting a fuming acid is avoided; and lastly the danger of destruction of sugar by contact with 12 N acid before complete mixing is much reduced. It is merely necessary to invert with 10 c.c. of the half strength acid instead of 5 c.c. of the concentrated.[2]

DETERMINATION OF THE CLERGET DIVISOR.

Final measurements.—It has been shown in this research that in Herzfeld's method the inversion temperature is so high that the reaction completes itself almost by the time the solution reaches the temperature of the bath, and that thereafter the time is so prolonged that serious decomposition ensues. Furthermore, it is not feasible for accurate measurement to shorten the time to the 5½ mins., which curve 3 shows to be sufficient, because then the latitude for differences in individual procedure is so small that the danger of over- or undertiming is very great. Consequently, Herzfeld's procedure, in spite of its almost universal use, is deemed unsuitable.

In a considerable number of preliminary experiments (which are not recorded here) it was determined: (1) That the reproducibility of polariscope observations by different observers is satisfactory; (2) that the type of saccharimeter is without influence on the results; (3) that the temperature coefficient is valid even to 30°C.; and (4) that the concentration correction now in use is valid.

Three variations of procedure were used, each of which has previously been shown in this research to yield a completely inverted solution with no subsequent decomposition. Eight experiments were made. In the first five, inversion was carried out at a constant temperature of 60°C. The velocity constant k in the formula:

$$k = \frac{1}{t} \ln \frac{R_0 - R_\infty}{R_t - R_\infty}$$

at 60° was found to be 0·4606. Consequently the time for 99·99 per cent. inversion is given by the formula:—

$$t = \frac{1}{0{\cdot}4606} \log \frac{100{\cdot}00}{100{\cdot}00-99{\cdot}99} = \frac{4{\cdot}0}{0{\cdot}4606} = 8{\cdot}7 \text{ mins.}$$

In a number of preliminary experiments, identical results were obtained when the time of heating was varied between 8 and 11 mins.

The procedure was as follows: Pure dry sugar was dissolved in water sufficient to make the volume 70 c.c., and the containing flask placed in the thermostat set at 60° C. When it had attained this temperature, 10 c.c. of hydrochloric acid (containing the same amount of HCl as 5 c.c. of 38·8 acid, i.e., 2·312 grms.), previously also heated to 60 C., were added. After 9½ mins. the mixture was removed from the bath, rapidly cooled, and placed in a thermostat at exactly 20° C. Each solution was observed in two different tubes, and by both authors independently.

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[1] *I.S.J.*, 1913, 328.

[2] Through a slight error in computation, the acid used in the final series of measurements was slightly more than half the concentration of the A.O.A.C., being 6·399 instead of 6·34 N.

In the sixth experiment the addition of the acid to the sugar solution was carried out at room temperature, placed in the bath at 60° C., agitated for 3 mins., and heating continued till the reaction was complete, namely 9 mins. It is striking to note that when heated from the temperature of the room, inversion is complete in nearly the same total time as when the sugar solution and the acid are previously heated to 60° C. before mixing.

In the seventh and eighth experiments, the procedure suggested by WALKER[1] was used, viz., heating to 65° C., and allowing to cool on the laboratory table. After 15 mins., the flask was placed in the thermostat at 20° C. The results of these eight experiments on the determination of the factor Clerget are given in the following table. The value of this factor *C* was computed by the formula:—

$$C = \left(\text{reading}\,\frac{26\cdot00}{\text{grms. sucrose/100 c.c.}}\right) - \frac{t}{2} - \text{concentration correction.}$$

This concentration correction, the reliability of which had already been established, was found from the value $(m - 13)\ 0\cdot0676$, m being the grms. of sucrose in 100 c.c.

Experiment No.	Weight sugar (air, brass weights).	Volume of solution.	Concentration of sucrose in solution.	Observed Rotation.		Temperature of observation.	Rotation corrected for temperature and concentration
				Observer J.	Observer G.		
	grms.	c.c.	g/100 c.c.	°S	°S	°C	°S
1......	25·175 ..	130·004 ..	19·365 ..	$-25\cdot05_4$ ..	$-25\cdot05_9$ ..	20·14 ..	—43·27
2......	25·382 ..	130·016 ..	19·523 ..	$-25\cdot31_1$ ..	$-25\cdot29_2$ ..	20·05 ..	—43·28
3......	25·428 ..	130·014 ..	19·557 ..	$-25\cdot33_6$ ..	$-25\cdot31_8$ ..	20·11 ..	—43·29
4......	30·209 ..	130·016 ..	23·234 ..	$-30\cdot26_7$ ..	$-30\cdot22_0$ ..	20·07 ..	—43·21
5	20·742 ..	100·185 ..	20·704 ..	$-26\cdot86_5$ ..	$-26\cdot87_3$ ..	20 09 ..	—43·27
6......	15·902 ..	100·183 ..	15·873 ..	$-20\cdot39_3$ ..	$-20\cdot41_5$ ..	20·01 ..	—43·24
7......	15·892 ..	100·185 ..	15·863 ..	$-20\cdot41_5$ ..	$-20\cdot39_0$ ..	20·07 ..	—43·29
8......	15·784 ..	100·000 ..	15·784 ..	$-20\cdot26_6$ ..	$-20\cdot27_8$ ..	20 11 ..	—43·26

Average .. .. —43·26

Correction from 0·640 N to 0·634 N acid .. .. + 0·01

Corrected value .. .. —43·25

The final value of — 43·25 obtained represents twice the rotation of 13 grms. of sucrose in 100 c.c., inverted by 5 c.c. of 38·8 per cent. acid, observed in a 200 mm. tube at 20°C., and augmented by the temperature coefficient 20·00/2. It is, therefore, comparable in every way with the previously determined values of HERZFELD. It is of course valid only in the presence of 0·634 N hydrochloric acid, the acidity produced in 100 c.c. by 5 c.c. of 38·8 per cent. acid. Herzfeld's value is 0·60°S. too low, an error of nearly two per cent.

Discussion.—Calculated from the least square equation, the error proves to be 0·007°S., though besides the "probable error" there still remains the possibility of constant errors affecting the result. Such error, however, that may exist in the final result is probably to be ascribed to the reading of the saccharimeter. It seems probable that the value — 43·25 is accurate to 0·01 or 0·02°S. It is hoped that other investigators will make measurements of this important constant.

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[1] *Loc. cit.*

Herzfeld in his communication describing the determination of his constant did not state upon what basis his saccharimeter scales were standardized; nor whether the unit of volume he used was the true c.c. or the Mohr unit. In neither case is the possible difference in standardization sufficient to account for the 2 per cent. variance. It is probable that his light source was not filtered. The authors found that a solution gave a reading of — 42·36 with the bichromate filter, and one of — 42·49 without it. If, therefore, Herzfeld's measurements were made with unfiltered light, his constant would have become still lower upon using the filter. Impurities in the sugar cannot conceivably have been present in amount sufficient to affect the results.

There remains the destructive effect of the acid during and subsequent to the inversion. An invert sugar solution containing 38·8 per cent. of acid is decomposed at 70° C. to an extent which per min. corresponds to a diminution in the constant of 0·056° S. During the 7½ mins. prescribed in the Herzfeld method, a decrease of 0·11°S. might result. It is difficult to understand how the decomposition can effect a diminution of the rotation greater than 0·15 or 0·20° S., which amount deducted from — 43·25 gives — 43·05.

Since in Herzfeld's method the specified time of heating is on a descending portion of the curve, the value obtained by any particular worker would depend upon the minute details of individual procedure. This fact precludes the possibility of reproducibility by different individuals, in illustration of which point it may be cited that while **Herzfeld** himself obtained — 42·66, **Walker** found — 42·78, **Tolman** — 42·88, and **Steuerwald** — 43·05. This condition is aggravated when the time is extended, as in the method adopted by the A.O.A.C. using 10 mins., which also increased the strength of the acid from 38·0 to 38·8 per cent.

It is due to such conditions that the Clerget process has acquired the reputation of being only an approximation. The authors contend that if the inversion is carried out under such conditions that the end of the reaction is situated on a broad and flat portion of the curve, relatively large differences in individual procedure can be tolerated without a diminution of accuracy. The accuracy of the Clerget divisor under such conditions is limited only by the precision with which polariscopic observations can be made. Source of error due to impurities will be discussed in the following section.

(*To be continued.*)

It is reported that the American Sugar Refining Co., has recently purchased large tracts of land along the new North Coast Railway, Cuba, upon which it will build several new mills. One plot adjoins the Cunagua mill, recently acquired by the Company.

We regret to announce the death on the 5th of June of Mr. W. H. Th. **Harloff**, the well-known Dutch sugar technologist. The deceased was born in August 1871 at Salatiga, Java, and studied at the secondary school at Semarang. His first appointment was as chemist of the Seloredjo sugar factory in 1890, and the following year he became factory manager at Pandaän. In 1892 he left for Europe in order to complete his studies at Berlin under the direction of Prof. A. **Herzfeld** at the Institute für Zuckerindustrie. Two years later the "Nederlandsch Indische Landbouwmaatschappij" appointed him factory manager at Goedo, Java, where he remained until 1898. During the period 1898 to 1903 he was engaged in cane cultivation, and after this he reached the position of "administrateur" or general manager of the Boedoeran factory, Java, which concern (previously in a bad condition) became a very prosperous enterprise under his able supervision. He returned to Europe in 1913, and subsequently contributed a number of articles to different periodicals, and also wrote in collaboration with Mr. H. **Schmidt** his standard work "Handleiding voor tropische witsuikerfabricatie," which has now reached its fourth edition. This book appeared in English under the title of "Plantation White Sugar Manufacture," and was also translated into Spanish.

American Commerce Reports.[1]

MARKET FOR CANE SUGAR MILL SUPPLIES IN ARGENTINA.

Throughout the Argentine sugar industry the machinery used is largely of European manufacture, owing partly to the lack of interest hitherto displayed by American houses in this field, and partly to the influence exerted by European capital and personnel, with which many of the ingenios operate. In general, the mill owners or administrators favour the same class of material which they have been accustomed to use in past years, and this fact makes it difficult to introduce new devices or goods.

The competition for this trade has been and is still very keen, since many of the local importers look to the sugar industry for a considerable portion of their business. Several European machinery and supply manufacturers are represented, while travelling salesmen from Buenos Ayres also cover the district. Within the last year two American firms specializing in this type of work have sent experienced sugar machinery men to establish themselves as resident engineers. Another company with American representations devotes its attention to pushing supplies and small material.

In the mills it is the usual practice to employ tandems of 9 or 12 rolls and 2 crushing rolls. Various systems of roll grooving are found, according to the type of mill installed, but renewals are made locally by machine shops in Buenos Ayres. The crushers, gears, couplings, and roll housings are all imported and, naturally, from the original makers.

The following list gives an idea of the number of different pieces of apparatus in use in 1913, without mention of size or make :—

Province.	Grinding Mills.	Defecating Pans.	Clarifying Pans.	Vacuum Pans.	Triple Effect.	Crystallizers.	Centrifugals.	Boilers.	Cranes.	Others.[2]
Tucumán....	95	272	102	184	62	207	540	291	94	1179
Jujuy	9	10	12	20	4	36	55	36	6	137
Salta	2	7	5	2	1	2	6	3	1	18
Santa Fe....	4	18	8	31	2	3	113	56	2	255
Corrientes ..	1	6	5	3	3	—	6	4	2	8
Chaco	5	7	25	8	7	21	23	18	1	111
Formosa	3	13	5	2	1	12	12	9	7	19
Total ..	119	333	162	250	80	281	755	417	113	1727

The boiling house, evaporating, and crystallizer equipment does not differ materially from that used 20 years ago. It is now obsolete in many respects, but is looked upon with a certain pride and admiration for its ability to continue in service, and efficiency is lost sight of. Any new material which is now going in will be much better than the older, but there is still much to be done in the way of re-design and better lay-out.

The centrifugals are nearly all belt-driven, with a considerable number of hydraulic and a very few electric-driven. Of the latter, some have the motor mounted beneath the basket.

The steam boilers operate with both bagasse and other fuel. The mill which handled the largest amount of cane in the crop of 1919 ground 286,567 metric tons, producing 19,558 metric tons of sugar, and consumed, in addition to all the bagasse, more than 50,000 tons of wood. It is estimated that during a crop the total expenditure of wood fuel is about 600,000 tons.

Belting of ordinary quality is made either on the estate of the ingenio itself or by local tanners. The demand for fine belting must be supplied from imported stock, especially the kind which is suitable for damp, sticky locations and for centrifugals where there is a heavy load due to frequent starting and stopping, with much shifting from tight to loose pulleys. Leather cup washers for the hydraulic-pressure cylinders are also made locally on a small scale, but the greater part are imported. American leather, both washers and belting, has found a good reception.

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[1] Culled from "Commerce Reports," published by the Department of Commerce, Washington. In many cases these are abbreviated here.

[2] Including superheaters, eliminators, filters, pumps, and distilling machinery.

Chain belting or roller chain is used extensively on cane and bagasse conveyors. The yearly renewals and replacements constitute one of the minor items in the yearly purchases, although it amounts to a sum that is worth working for. Except in new installations material of this sort would have to be suitable for joining with that already in operation.

Filter cloths and woven wire baskets or centrifugal linings formerly came from Europe. These linings had the particular feature of being easily formed by withdrawing one of the weft wires and reinserting it, locking together the two ends to form the cylindrical basket. This type is no longer in evidence but is looked for upon resumption of commercial relations with Germany. Perforated metal sheets used for straining juice and for several other purposes are purchased in considerable quantities. Dimensions, shape, and sizes of holes depend upon the service to be performed. Some filter cloth is made in the country, but the best grades are imported, coming now largely from Spain. The demand for this material is very considerable in proportion to the sugar produced, and American cloth, properly introduced, might secure a good share of the trade if prices and terms are right.—[Trade Commissioner's Report, June, 1920.]

THE DEMAND FOR SUGAR MACHINERY IN MAURITIUS.

Though small in area—being only 39 miles long by 29 miles wide—the British island of Mauritius produced last year about 300,000 tons of sugar, as compared with 185,000 tons for the whole Province of Natal, Union of South Africa, which is only slightly smaller than Cuba. It is stated that the gross revenue from the sugar industry of this small island last year was in the neighbourhood of £20,000,000 ($97,330,000).

There are 59 sugar estates, each operating its own mill. These mills have their own light railway systems for cane haulage, equipped with steam locomotives and steel cane wagons. These light railways are 60 centimetres to 90 centimetres gauge, with 75 to 80 centimetres probably the most common (1 centimetre = 0·3937 in.) Ten kg. (22 lb.) rails are used, and the locomotives weigh on the average about 10 tons, while the cane wagons probably average 2 to 2½ tons capacity, the units above being metric tons in all cases.

Prior to the war many of the planters were none too well off financially, but the recent abnormally high sugar prices have cleared away most of their indebtedness, and the majority of the planters are now quite strong financially. It is reported that the last sugar crop brought in a profit to the mills of about £12,000,000 ($58,398,000), and consequently, while in the past the planters were dependent upon certain large local British houses for long-term credits, and thus were practically forced to buy only what those firms had to offer, they are now in a position to buy more in the open market and are showing a tendency to purchase from local Mauritian houses, rather than from foreign-owned concerns. The Mauritians are of French descent, and the island was formerly a French possession, so that there is considerable nationalist sentiment among the Mauritians in their buying.

It is stated that practically all of the sugar machinery in the Mauritian mills is of British manufacture; and, with the exception of one American company, it does not appear that American manufacturers have ever entered the market. In view of the fact that the local British houses represented Scotch sugar manufacturers, and that these houses had more or less hold upon the Mauritian planters because of long-time credits, it is, of course, natural that it has been difficult for any American manufacturer to break in. Conditions now are changed, however, and it is believed that American manufacturers, working through local Mauritian houses, should be able to do considerable business. To show what can be done, the representative of a British manufacturer of light tramway material who recently made two short trips to Mauritius, spending probably not more than six weeks total in the country altogether, secured orders for £130,000 ($632,645) worth of material. Formerly this tramway business was said to have been largely held by KOPPEL-ORENSTEIN, of Germany, who were very active in the South African and Mauritian markets.—[Trade Commissioner's Report, July, 1920.]

THE JAVA SUGAR MARKET AND THE POSSIBILITIES OF SUGAR CULTIVATION.

Between the producers and the buyers for export of sugar in Java there is a large body of speculators, which constitutes the second-hand market, the first-hand sales being made by the Javasche Suiker Vereeniging, an association of 160 of the largest sugar mills in Java, and by the 26 smaller individual mills making about 10 per cent. of the sugar produced on the island. Some of these latter, owned by Chinese, are prominent in the second-hand market, though their product is not handled in the same conservative manner as that of the Javasche Suiker Vereeniging mills. The ultimate buyers, in Java, the exporters of sugar, are few in number, though, with their many decades of experience, they lead and regulate the market to some extent, especially one Dutch, one British, and one German firm.

The speculators of the second-hand market are mainly Chinese, although many British-Indian and European exporting houses often hold large quantities for their own account, and the Japanese are said to have made heavy speculative purchases of the 1920 crop. The Chinese watch the exporting houses closely and, when these begin to buy from the mills, enter the market at slightly higher prices, figuring on the usual advances when forward deliveries become spot deliveries, and on controlling the market by pooling their holdings at the end of the campaign, when all the sugar is out of first hands. In 1917, however, the customary rise in the market gave way to a heavy decline, and the Chinese suffered some very heavy losses. The losses over the amount paid by the bankrupts were borne by the mills. The new Javasche Suiker Vereeniging, formed in August, 1918, made very stringent rules as to margins protecting the mills in case the market dropped.

On March 1st, 1920, there were approximately 1,500,000 piculs (one picul = 136·16 lbs.) of the 1919 crop still in Java, while of the 1920 crop, which will be milled between May and November, there were 4,800,000 piculs remaining unsold by the Javasche Suiker Vereeniging, and an estimated 1,250,000 piculs, or one-half the amount milled by the 26 independent mills, still remaining in first hands.

There is much conflicting opinion about the probabilities of the continuance of the present high prices for sugar. Some brokers point to the general rise in values throughout the world, and consider the present prices fully warranted. Others fear that Japanese speculators who, during a sudden drop in the market in July, bought heavily of superior sugar, for which there is no demand in the Japanese refineries, will throw their holdings on the market at a critical time, with disastrous results. The Javasche Suiker Vereeniging, by requiring heavy deposits, recognizes the possibility of a slump.

August is considered to be a critical time each year. In that month heavy deliveries are made to buyers, and the situation of the speculators is generally well known to the large exporting houses, who may put them in an embarrassing position by not buying as quickly as deliveries are made.

The extension of sugar areas in the Dutch East Indies depends, first, on the extension of irrigation works, and in a hardly less degree on the development of mechanical cultivation. Lands most suited to the growing of cane have already been taken over by the present milling companies, and any new areas would have disadvantages to be offset by cheaper methods, or the difference deducted from the profits.

The Government has placed many restrictions around the extension of sugar areas in Java where labour can most easily be obtained, and climatic and soil conditions are most conducive; and it is thought that only through extensive cultivation with the use of machinery and a minimum of labour will there be further development.

In South Borneo the Japanese have acquired lands which they are said to be intending to open up to sugar. In southern Celebes, south and east from Macassar, there are lands that can be used for sugar, but here, as well as elsewhere throughout the Outer Possessions (that part of the colony outside of Java and Madoera), the planter will have to depend upon imported labour. Though Sumatra presents some phases favourable for a sugar-producing country, the production costs there of one sugar plantation do not seem to warrant the extension of the industry.

Machinery is looked upon as the only possible means of opening up further sugar lands, and as the American caterpillar tractors have proved themselves suited to the work required for the sugar fields in Java, it is hoped they will solve the problem of developing the vast areas now lying unproductive in this colony.

Sugar planters in Java are confronted with many labour difficulties, especially at the time when labour is needed the most, for at those times the population is busy with crops of rice and other native cultures. It is claimed by the "Sugar Syndicate," that they are being forced to the use of mechanical appliances for the cultivation of their fields, and a committee has been appointed to investigate the use of tractors for ploughing and ditching.

For many years the chairman of this committee has been experimenting with tractors and now has three American machines at work on his plantation. The first one, brought out in 1914, was a 60 H.P. caterpillar machine of a standard American make, but it was found to be too lightly powered for the work in the heaviest ground. On light ground this tractor was able to handle a six-furrow plough, making an average of 5½ acres daily, and while it did not prove the right one for the work required, there were many points in its favour, and in 1915 a 75 H.P. machine of the same make was brought out.

This tractor was found to be more satisfactory, being able to handle the plough in the heaviest soil, making six furrows at once with a daily average of 7 acres. The third machine was 120 H.P., with which experiments have been made since 1917. It has proved satisfactory in power and mechanical construction, but the tread does not hold in the wet clay under heavy loads, the heaviest of which is in making ditches for the final planting of the cane. These are made in pairs, 5 ft. from centre to centre and 22 in. deep. The clay of Java, as found in most sugar districts, is of a peculiar, heavy quality, very sticky when wet. Local engineers have been experimenting with the tread of this 120 H.P. tractor, but without satisfactory results.

Providing mechanical cultivation can be made practical, Borneo, the Celebes, and Sumatra present possibilities for the extension of the sugar industry in the Dutch East Indies. However, the acreage of Java in sugar alone promises a good market for tractors when one suitable for the work is developed. This work is strenuous, acknowledged to be the heaviest in the colony, especially in view of present labour troubles; but if a tractor is furnished which meets the demands, modifications will be designed for other cultures and a market opened up for ploughs, harrows, cultivators, rollers, scrapers, and other soil-working implements. It will only be a step from that point to mechanical cutting and loading of the cane in the field. The potential market for ploughs and ditchers is especially emphasized, and the close co-operation of manufacturers is solicited for the working out of the problems presented by conditions peculiar to the locality in order to insure the proper development of this market.—[Trade Commissioner's Report, June, 1920.]

SUGAR PRODUCTION IN MADEIRA.

Due to unfavourable climatic conditions and a lack of chemical manures, the crop of sugar cane was small in 1919. About 43,000 metric tons were produced, valued at about 920,000 escudos. (The escudo was normally worth $1·08, but during 1919 its average value was about $0·52). Of this quantity, about 21,000 tons were purchased by the British sugar refinery operating in Madeira which produced 1700 tons of sugar. Of this total, 400 tons were shipped to Portugal, and the remainder was used locally. The 1918 production was 2527 tons, which was only about half the normal amount.

More than half of the cane crop was turned into cane brandy or "aguardente," and as a result 550 tons of raw sugar had to be imported from Mozambique to supply local needs for sugar and alcohol. About 2000 tons of molasses were imported from Cuba. A recent decree limits the total production of this brandy to 700,000 litres in 1920, and ordains that the production shall be reduced by 100,000 litres annually until it reaches the minimum of 200,000 litres in 1925.

Similar laws in the past have been frequently evaded, however, but it is to be hoped that the new decree will be more strictly observed. The brandy is a popular drink, particularly among the peasants, and is an extremely profitable article to manufacture and sell. Hence, it is difficult to enforce restrictive laws.—[Consular Report, May, 1920.]

Publications Received.

Principal Insect Enemies of the Sugar Beet. By Asa C. Maxson. (Great Western Sugar Co. (Agricultural Department), Denver, Col., U.S.A.) 1920.

Urged by the wise policy of having at hand information in a readily available form for the application of proper measures against insects attacking the sugar beet, the Great Western Sugar Company, of America, have requested their staff entomologist, Mr. Maxson, to compile this "bulletin." It is, in fact, a well-illustrated textbook written for the use of the grower in order to aid him in identifying any particular insect which may cause injury to his crops. It commences with a "key," the intention of which is to indicate from the observation of the damage done to the plant the general class of insect, if not the particular one, concerned in the attack. A very excellent series of coloured plates are provided; and it is probable that these will furnish an easier and more positive means of identification than any "key" is capable of doing in the case of the beet farmer. In Chapter I, after discussing "insects in general," their development and classification, a good practical account is given of methods of control, including so-called natural methods, as crop rotation (perhaps the most important of all), burning, etc., and "artificial methods," as the use of various forms of insecticide. Advice is given on the preparation of remedies that have proved the most efficacious under local conditions, and on their application, using sprayers or otherwise. Chapters II and III deal with the various root feeders and leaf feeders respectively; and the concluding chapter discusses the beneficial insects found in beet fields, predacious and parasitic. There is a bibliography, and also an appendix giving an alphabetical list of the names of insects as they are popularly known in the American beet fields, together with their scientific names and corresponding references to information and illustrations given in this book. A good index has been compiled.

Cocoa and Chocolate: Their History from Plantation to Consumer. By Arthur W. Knapp, B.Sc., F.I.C. (Chapman & Hall, Ltd., London.) 1920. Price: 12s. 6d. net.

This small work has been written for the general reader. It gives in untechnical language an outline of the present methods used in the cultivation of cacao, its harvesting and sale, and especially treats of the manufacture of cocoa and chocolate from the raw material. In spite of its popular nature, it contains a good deal of value to the technologist. There is, for example, a very good account of the process of cacao fermentation (upon which topic the author is an acknowledged authority); while the chapter on "By-products of the Cocoa and Chocolate Industry," as well as that on "The Composition and Food Value of Cocoa and Chocolate," are certainly also worth perusal by specialists. Notwithstanding the research that has already been carried out on the production of cacao, it is made clear that there remains a large and profitable field for further work, either, it may be added, on the part of the recently formed British Association of Research for Cocoa, Chocolate, etc., or other body, or individually. In connexion with this point, it is mentioned that at the present time some 7,000,000 or 8,000,000 gallons of "sweatings" containing some 15 per cent. of solids, of which about half consists of sugars, are run to waste annually. Mr. Knapp's book should prove a useful introduction to the subject. It is written in a clear and pleasing style, and contains a large number of well-chosen photographs, sketches of plant, and maps, and lastly, a useful bibliography.

Programme for the Session 1920-21 of the Department of Technology, City and Guilds of London Institute. (John Murray, Albemarle Street, London, W. 1.) Price: 2s. 6d.

This booklet contains the general regulations and syllabuses for the examinations in technological subjects held by the City and Guilds of London Institute. Attention was recently directed to the examination in Sugar Manufacture.[1]

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[1] *I.S.J.*, 1920, 439.

Steam: Its Generation and Use. Ninth British Edition. (Babcock & Wilcox, Ltd., Oriel House, London, E.C. 2.)

This volume, well known to engineers and steam users all over the world, is recognized as a reliable textbook on the present practice of steam production. It contains articles on the theory of steam making; the circulation of water in boilers; the properties of saturated steam; the percentage of efficiency; types of the B. & W. water-tube boiler; fuels and furnaces; priming; the prevention of incrustation; chimneys; flue gas analysis; etc., etc. There are numerous illustrations, and attention may be directed to a number depicting types of bagasse furnaces in conjunction with water-tube boilers, which have been installed by Messrs. Babcock & Wilcox in different sugar-producing countries.

A Course of Practical Chemistry for Agricultural Students. By L. F. Newman, M.A., F.I.C., and H. A. D. Neville, M.A., B.Sc. (Cambridge University Press, Cambridge.) 1920. Price: Vol. I, 10s. 6d. net; Vol. II, Part I, 5s. net.

This Course comprises a series of laboratory exercises for the use of students specializing in practical agricultural chemistry. Volume I is divided into 43 sections dealing with the chemistry and physics of the soil; and describes experiments illustrating the principles of inorganic chemistry and elementary analytical practice as applied to the examination of plant ash, soils and manures. Volume II, part I, has 20 sections, and is devoted to similar simple laboratory work, but in pure organic chemistry. In addition to the directions relating to practical work, a series of notes has been added in explanation of each experiment made, these notes in fact constituting an outline of the theory underlying the practical work, and serving as a laboratory guide to the student. Although designed primarily for those taking the course for the degree at Cambridge University, these exercises would prove of value to students of agriculture generally. They are well-chosen, particularly those dealing with the examination of soils and manures, and the directions given for carrying out the experiments lack nothing in lucidity. These two volumes on the whole are really excellent, and should give the student a reliable foundation upon which to build a larger knowledge of the subject.

Chemical Calculation Tables for Laboratory Use. Horace L. Wells. Second Edition, revised. (Chapman and Hall, Ltd., London) 1920. Price: 7s. 6d. net.

One of the principal features of this book is a table of logarithms of numbers, provided with a double thumb-index, which should prove a useful device in practice. It also gives various tables among which are the latest international atomic weights; gravimetric factors; formula weights, factors for indirect analysis; reduction of gas volumes, and values for gas analysis. There is also a table of multiples for organic compounds. This book of tables should be of value for everyday use in the laboratory as a means of avoiding errors of calculation, as well as making the work more rapid and less laborious than is often the case.

Among other recent publications are the following:—

Die Fabrikation des Rübenzuckers. Richard von Regner. Second Edition; 60 illustrations. (A. Hartleben's Verlag, Wien.) 1919. Price: M. 4·80.

Rübensirup, seine Herstellung, Beurteilung und Verwendung. Berthold Block. First edition; 71 illustrations and a table. (Otto Spamer, Leipzig.) 1920. Price: M. 24 plus 40 per cent.

Die Polarisationsapparate und ihre Verwendung. Dr. Hans Schulz and Dr. A. Gleichen. First edition; 80 illustrations. (Verlag von Ferdinand Enke, Stuttgart.) 1919. Price: M. 12.

Brevities.

A new sugar central is under construction in Columbia, at Sautata, on the river Atrato.

The Kelvin Engineering Company are now located in new offices at 106, Front Street, New York.

Central Hershey, Cuba, during the crop just completed, produced no less than 14,908 tons of plantation white granulated, the polarization of which averaged 99·2°. No other grade was made, and the purity of the final molasses is given as 35°.

The Trinidad Government have fallen in with the Committee proposals relating to the establishment in that island of a Tropical Agricultural College, and are prepared to afford the necessary facilities and give the college adequate support. St. Augustine's Estate, Trinidad, will accordingly be the site of the new training centre.

Destruction by fire of a steamer off the coast of Natal led to the total loss of a valuable cargo of sugar machinery bound from England to Mauritius. The same vessel had just unloaded a similar consignment for a Natal estate, or a double loss would have been recorded.

We welcome the re-appearance of *La Sucrerie Belge*, the publication of which was suspended in August, 1914. Our contemporary, which was first issued in 1872, is the official organ of the Société Général des Fabricants de Sucre, and of the Société Technique et Chimique de Sucrerie, of Belgium. It is now edited by Dr. C. TYDOADT, and will appear monthly.

A pleasing feature of the Annual Meeting of the Society of Chemical Industry, held in July, at Newcastle-on-Tyne, was the presentation of the gold medal of the Society to M. PAUL KESTNER, President of the Société de Chimie de France. Among M. KESTNER's most notable engineering inventions are the climbing film evaporator, the scaleless water-tube boiler, the use of forced draught in acid towers, and the automatic acid elevator.

At the beginning of August, according to WILLETT & GRAY, the balance of sugar in hand in Cuba was just over 700,000 tons. Part of this quantity was held by a so-called syndicate and part by speculators, who had paid prices much above those latterly prevailing. Since the Royal Commission and other European countries had by then taken practically all sugars contracted for, this stock was all available for the United States.

It is proposed by the Council of the Society of Public Analysts to appoint an Analytical Standards Committee in the United Kingdom to deal with the question of standard samples of chemicals, metals, alloys, ores, and other products, which is now being met by private enterprise and the use of the samples of the U.S. Bureau of Standards.

It is much to be regretted, writes Mr. HENRY PARSONS,[1] that the Memorandum issued by the Fuel Research Board[2] is of so negative a character. Our coal measures cannot be replaced, and it is futile to hope for much in the way of compressed gas, experience with which during the war was not very hopeful. In different countries ample supplies of alcohol fuel will be available shortly, and if something is not done in Great Britain we shall find possible supplies of raw material for alcohol fuel denied us when most we need them. Many tropical and sub-tropical countries can produce unlimited amounts of vegetable matter for the production of fuel alcohol, and encouragement of private development is wanted. Something should be done to leave the ground clear by the removal of all restrictions in regard to manufacture and use with suitable safeguards, so that private enterprise can show what it can do.

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[1] *Chemical Trade Journal*, 1920, 67, No. 1734, xxv.

[2] *I.S.J.*, 1920, 429-430.

Review of Current Technical Literature.[1]

Microscopical Examination of the Scums obtained in the Carbonatation Process.

H. Claassen. Zeitschrift des Vereins der deutschen Zuckerindustrie, 1920, No. *772, 203-223.*

It has been generally accepted for some time past that in the filtration of the carbonatation scums it is the physical nature, rather than the chemical composition, of the constituents composing the precipitate that influences this operation favourably or otherwise. In spite of this, it seems surprising that hitherto no one has endeavoured systematically to follow the processes of liming and saturation by means of a microscopical examination. On taking up an investigation on these lines, it was observed in the case of pure solutions of calcium salts (e.g., the chloride) that the calcium carbonate which is precipitated, say by a solution of sodium carbonate, is always crystalline, being partly in the form of needles, and partly rhombohedral. A warm solution of calcium saccharate on being treated with carbon dioxide gives a precipitate consisting of very small particles, mostly of indefinite form, between which small crystals are sometimes to be seen. In cold calcium saccharate solutions a slimy precipitate at first appears, but after a short time well-developed crystals result. Calcium trisaccharate in suspension in water when treated with carbon dioxide is transformed without dissolving into calcium carbonate of grainy structure but no definite form. Carbon dioxide, when passed into milk-of-lime, combines directly with the solid particles in suspension, the calcium carbonate produced retaining the same form apparently as the particles of lime originally had, but appearing opaque under the microscope, instead of transparent as formerly.

Coming now to the carbonatation of beet juices under factory conditions, it will be realized from what has been said that the scums originate from the combination of the carbon dioxide, partly with the soluble calcium saccharate, and partly with the solid particles of lime, though it is impossible to state which reaction predominates. At any rate, it is of importance to note that when hot limed juice is saturated with carbon dioxide the particles composing the precipitate never have any decided crystalline form. However, if after filtering off the calcium carbonate a second saturation be operated in order to throw down any lime still remaining in solution, a precipitate is obtained which contains small though well-formed crystals. On the other hand, if after filtering off this first carbonatation juice a further quantity of milk-of-lime be added, crystal formation does not appear to occur when carbon dioxide is passed in.

On observing more closely the effect of the process of carbonatation on raw beet juices, it can be seen that the slimy constituents are rendered capable of filtration by the adherence to them of the precipitated calcium carbonate. This intimate combination, as well as the regular distribution of the particles of calcium carbonate throughout the space between the resulting agglomerations, cannot be accomplished (completely, at least) simply by the addition of calcium carbonate or of carbonatation scums, saturation of the suitably limed juice with carbon dioxide being necessary. Whether the precipitated calcium carbonate is in the form of crystals, or in that of amorphous grain, seems to be of secondary importance from the point of view of good filtration, the essential matter appearing to be its even distribution on and between the slimy particles. It is further obvious that the proper proportion of the calcium carbonate to the slimy substances thrown out of solution by the lime is likewise a condition that must be fulfilled.

Very striking is the microscopical examination of the viscous juice obtained from deteriorated roots when treated by carbonatation. On the addition of the lime, the slimy particles appear to be precipitated in a swollen-out condition, but on the diminution of the alkalinity as saturation proceeds they shrink again, becoming at the same time more transparent than previously. It follows from what has been mentioned above that in the treatment of such deteriorated juices the quantity of lime used must be increased, sometimes by several times the normal amount; but this results in such a viscous mass that saturation can be effected only with difficulty. It is, therefore, recommended when dealing

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[1] This Review is copyright, and no part of it may be reproduced without permission.—(Editor, *I.S.J.*)

with rotten roots that the juice should be mixed with water in proportion to the amount of slimy substances that may be present, that the usual percentage amount of lime should then be added (calculated on the diluted juice, and not on the roots as customarily), and that finally the liquid should be carefully saturated.

Pycnometer for the Determination of the Density of Molasses. *W. B. Newkirk. Technologic Paper, No. 161, Bureau of Standards, Washington, D. C., U.S.A.* (Preliminary abstract.)

Owing to the high viscosity of molasses, the dissolved gases it contains, and the presence of air which is introduced when mixing, the exact determination of the density of this product is a matter of some difficulty. In order to obviate these sources of error, a pycnometer bottle, the volume of which is controlled as in the bottle of Johnson and Adams, [1] has been designed by the author, an expansion chamber [2] fitted with a connexion leading to a vacuum apparatus being also added. Results agreeing with one another by less than a few hundredths of a per cent. of the dry substance present were thus obtained. It was observed that heating the molasses may often induce a certain amount of decomposition to take place, the extent of which is indicated by this method. A perfect separation of the gases can be obtained, and the method appears to be a very satisfactory one. It is hoped later to publish fuller details when these are available.

Deterioration of Cuban Raw Sugars in Storage. *Nicholas Kopeloff and H. Z. E. Perkins. Journal of Industrial and Engineering Chemistry, 1920, 12, No. 6, 555-558.*

A number of 320-lb. bags of Cuban sugar were examined chemically and bacteriologically while stored during a period of 5½ months under conditions approximating as closely as possible to those obtaining normally. At the end of the period, the polarization of the contents of all the bags had fallen, this decrease being accompanied by an increase in the reducing sugars, inversion of the sucrose thus being indicated. There was also a gain in the moisture content, and a reduction in the factor of safety.

In most instances the factor of safety was initially over 0·35, but in some it was between 0·22 and 0 30. [3] It has previously been pointed out that in the case of infection by moulds a sugar with a factor lower than 0·30 may be unsafe during storage when the number of these is sufficient. This would seem to apply also to infection by other micro-organisms; because in those cases in the present investigation in which the highest counts were made, deterioration occurred with a factor which initially was less than 0·30. It would in fact seem possible to predict the keeping quality of a raw sugar by correlating the number of micro-organisms with the factor of safety. Thus, these authors believe that if there are present in the raw sugar more than 100 micro-organisms per grm., and the factor is greater than 0·2, deterioration may be expected.

Determination of the Carbohydrates of Cacti. *Herman A. Spoehr. Publication No. 287, Carnegie Institution of Washington, 1-40.*

An investigation has been carried out at the Desert Laboratory, Tucson, Arizona, U.S.A., in order to gain a clearer understanding of the equilibria and mutual transformations of the various groups of carbohydrates in the chlorophyllous leaf, as well as of the fate of these substances in the general metabolism. The greater part of the work was conducted with one species only of cactus, *Opuntia phæacantha*, known locally as *O. blakeana.*

Preliminary examination having shown that the major portion of the carbohydrates is present in the form of polysaccharides from which the monosaccharides and disaccharides can be separated by extraction with alcohol, the following scheme of analysis was followed (the results being calculated in terms of the number of c.c. of standardized Fehling's solution[1] reduced per grm. of the dry plant material), and the volumetric iodide method which will be described in a later abstract being applied. A—Total sugars on hydrolysis at boiling point with 1 per cent. of hydrochloric acid for three hours, giving the hydrolysed polysaccharides as well as the monosaccharides. B—Sugars remaining after fermenting away the residue of A, giving the total pentose sugars (including monosaccharide pentoses and pentosans). C—Monosaccharide, hexose, and pentose sugars obtained by extracting another portion of the sample with 95 per cent. alcohol. D—Sugars resulting from the hydrolysis of C, or inverted disaccharides, original hexoses and pentoses. E—Sugars resulting after fermenting D, that is, monosaccharide pentoses. Then, the several cupric reducing values obtained represent the following groups of sugars: A, total sugars A–D, total polysaccharides; D–E, disaccharides plus hexoses; A–B, total hexose sugars; (A–B)—(D–E), hexose polysaccharides; C, monosaccharides; D–C, disaccharides; C–E, hexoses; B, total pentoses; E, monosaccharide pentoses; and B–E, pentosans. On applying this scheme of analysis to *O. phæcantha*, the results (calculated on the dry matter) obtained were as follows, the water content of the original material being 23·3 per cent.: Total sugars, 16·60; total polysaccharides, 15·15; disaccharides and hexoses, 1·10; total hexose sugars, 8·50; hexose polysaccharides, 7·44; disaccharides, 0·36; monosaccharides, 1·20; hexoses, 0·74; total pentoses, 7·70; pentoses, 0·46; and pentosans, 7·26 per cent.

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[1] *Jl. Amer. Chem. Soc.*, 1912, 34, 586.

[2] See also *I.S.J.*, 1913, 489.

[3] See *I.S.J.*, 1918, 227; 1919, 278.

CARBOHYDRATE ECONOMY OF CACTI. *Herman A. Spoehr. Publication No. 287, Carnegie Institution of Washington, 40-79.*

It was established that the polysaccharides are present in plants of the cactus group of plants mainly in the form of starch, and also of a mucilagenous substance of a pentosan nature, but it was found impossible to determine the starch separately by means of taka-diastase, owing apparently to the protection of the starch granule by the slime. Hydrolysis of this mucilage showed that 34·1 per cent. was d-glucose, and 65·9 l-xylose. Other points mentioned were that the pentose sugar remaining after the elimination of the hexoses by fermentation was mainly l-xylose; and that in the residue remaining after the fermentation glucuronic acid was present, this being the first time this body has been reported as a plant constituent.[1]

A study was made of the behaviour of the carbohydrates under varying climatic conditions. Thus, it was noticed that when high temperatures prevail with a low rainfall the polysaccharides increase, the monosaccharides and disaccharides (mostly sucrose with a trace of maltose) decrease, and the pentosans increase; while when the temperature is low and the rainfall high, the converse results are obtained. It is significant that the greatest activity of the plant comes at the time when the content of monosaccharides and disaccharides is highest. The vegetative shoots and flowers are developed in March, at which time the general process of inversion has reached its maximum. This carbohydrate inversion taking place as a consequence of low temperature and ample water supply can be prevented by artificially keeping the plant either at a higher temperature or a lower water supply, in neither of which cases does the plant then develop vegetative or flower buds at the regular season. A striking property of many cacti is their ability to survive long periods of drought and starvation. It is here shown that these plants do not go into a condition of rest when the water supply is greatly diminished, but continue their respiratory activity at about the same rate as when supplied with abundant water by virtue of their ability to use as food not only the simpler monosaccharides (which under these circumstances are present in reduced quantities), but also the polysaccharides, the starch slowly disappearing. Little is known of the origin and physiological rôle of pentoses in the metabolism of the higher plants. Regarding formation, it is believed that it may be due to the splitting-off from glucuronic acid of carbon dioxide from the carboxyl group, l-xylose thus resulting. In reference to the significance of pentosan production to this plant, it is pointed out that its most striking property is its mucilagenous character, causing it to swell and take up an enormous amount of water when available. Hexose-polysaccharides do not exhibit this property in nearly so marked a degree. Pentosans act as hydrophile colloids and are products of arid conditions. Their presence opens the way for a new conception as to the origin of the morphological character of succulent plants, based upon physiological principles.

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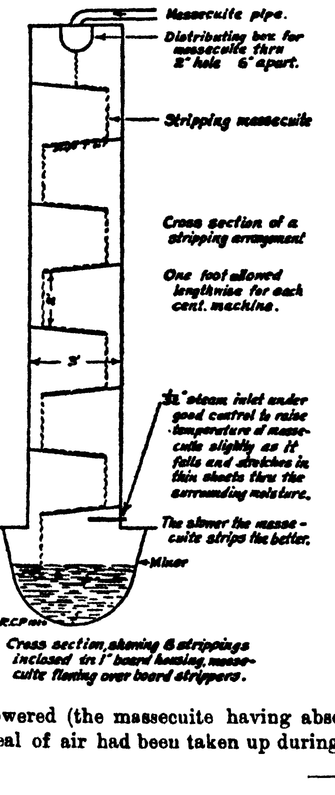
[1] 100 c.c. of Fehling's solution were found equal to 1·00 grm. of d-glucose; 0·95 of invert sugar; 0·96 of l-xylose,; 0·90 hexose polysaccharides; and 0·85 of pentose.

[1] It has been found as a product of glucose metabolism in mammals.

EXPEDITING THE PURGING OF THE LOW-GRADE MASSECUITES OF HIGH DENSITY. *R. C. Pitcairn. Paper read before the Hawaiian Chemists' Association, April, 1920.*


Massecuite pipe.
Distributing box for massecuite thru 2" hole 6" apart.
Stripping massecuite
Cross section of a stripping arrangement
One foot allowed lengthwise for each cent. machine.
3'
1½" steam inlet under good control to raise temperature of massecuite slightly as it falls and stretches in thin sheets thru the surrounding moisture.
The slower the massecuite strips the better.
Mixer
R.C.P.

Cross section, showing 6 strippings inclosed in 1" board housing, massecuite flowing over board strippers.

A number of methods for the preparatory treatment of the massecuite with the object of lowering its viscosity were tried, among which may be mentioned, passing between rollers, vibration, stretching, screening; but the best results were obtained by what is here termed the "stripping process." It is very simple; and consists in allowing the massecuite to flow by its own weight over a number of stripping boards, or baffle plates, set approximately 2 ft. apart, one above the other (as is shown in the sketch), thus stretching the product into thin sheets by its own weight. Dry steam is allowed to circulate around the falling massecuite, and the improvement in the rate of purging is very marked. The steam, however must be well regulated, otherwise the condensate raises the purity unduly; and 37°C. seems to be the highest temperature to which the massecuite should be heated.

This is considered to be a simple mechanical device for applying heat cheaply, evenly, and to a limited degree before purging. It is capable of reducing the time of centrifugalling by 25 to 35 per cent., so that the capacity of the machines devoted to the spinning of the low-grades is increased, and a higher re-melt sugar is obtained. Laboratory tests showed that during the "stripping process" the Brix is lowered (the massecuite having absorbed water), and it was also noticed that a good deal of air had been taken up during the operation.

AN UP-TO-DATE REFINERY LABORATORY. *H. A. Granary. La. Planter, 1920, 65, No. 2, 27-28.*

A short description is given of the recently equipped laboratory attached to the Cuban Sugar Refining Co., of Cardenas, Cuba. Its walls are of Upson board, painted with Toch Bros.' "R.I.W.," and finished in hospital enamel, and two sides of the rooms are almost entirely of glass, making it very light and cool. All the benches are supported from the walls, so that there are no columns or legs from the floor The equipment is as complete as it is possible to make it; in addition to the usual routine work concerned with sugars, liquors, molasses, and char, analyses are made of the materials used in the sugar-house, as fuel oil, lubricating oils, lime, phosphoric paste, etc. There are also departments for special research, for bacteriological work, and also for the standardization of all the glassware (flasks, pipettes, hydrometers, thermometers, etc.) used in the factories of the Cuban-American Sugar Co., of which the Cuban-American Refining Co. is a subsidiary concern.

In giving a description of the control work, it is stated that this consists chiefly in the grading of the sugars and the analysis of the molasses. Determinations are made of the size of the grain, its colour, hardness, insoluble matter, ash, etc.; and of the sucrose content (by CLERGET), reducing sugars and ash of the molasses. A Bausch & Lomb "Balopticon," Model C., is used for rapidly ascertaining the size of the grain, and by means of this instrument an image of the crystals (multiplied ten times) can be cast on a screen, on which the sizes corresponding to the several standards are drawn.[1] A Hess-Ives Tint Photometer[2] serves for recording the colour of the sugars; while specific gravity determinations are conveniently and exactly made by the "Chainomatic" balance,[3] which is claimed to be much superior to the Westphal apparatus or the hydrometer. Mr. GEO. P. MEADE is the director of this laboratory (and also superintendent of the refinery). He is assisted by Mr. J. B. HARRIS and a competent staff of chemists.

PROPORTIONS OF PECTIN, ACID, AND SUGAR FOR THE PREPARATION OF JELLY. *C. H. Campbell. Journal of Industrial and Engineering Chemistry, 1920, 12, No. 6, 558-559.*

While much has been said as to the proper amounts of acid and sugar, nothing has come to the author's attention which states a definite proportion of pectin as the fundamental basis for the manufacture of commercial jelly. He has found (1) that an excess of pectin produces a firm and tough jelly, but decreases the yield, so that a pectin content of 1·25 per cent. produces a fine commercial jelly, and one of 1·0 or 0·75 per cent. gives a delicate quality resembling the home-made product; (2) that an acidity of 0·3 per cent. (calculated as sulphuric acid) is necessary to produce a good quality, the minimum being 0·27 and the maximum 0·5 per cent.; and (3) that an excess of sugar produces a soft jelly, and an insufficient amount results in a tough one. A series of experiments was made, in which the pectin content varied, while the acid and sugar contents was kept constant, the juice used being prepared by boiling apple pomace for 2 hours with 0·5 oz. of citric acid or tartaric acid per lb. Four series of tests were made, giving jellies some of which were satisfactory and others too soft, the results obtained in the last series being as follows:—

	ORIGINAL JUICE.	JUICE DILUTED TO			1 PER CENT. PECTIN BASE WITH INCREASED SUGAR.
Pectin, per cent.	1·59	1·25	1·0	0·5	—
Volume, gallons (American)	1·5	1·5	1·5	1·5	1·5
Specific Gravity	1·017	1·012	1·008	1·006	1·017
Acidity, per cent.	0·25	0·21	0·176	0·113	0·25
Sugar added, lbs.	5 lbs.	5 lbs.	5 lbs.	5 lbs.	8
Acid added (teaspoonful)	1	1	1	1	1
Cooking temperature (F.)	219	219	219	219	219
Yield, 8 oz. glasses	16	18	18·5	17	28
Quality	Very firm	Firm	Delicate	Soft	Good

Thus, no matter what the percentage of pectin in the juice was originally, the same yield of jelly was obtained. In order to ascertain the amount of sugar producing the best quality of jelly for commercial purposes, a series of tests was run with various amounts of sugar per gallon (American[4]) of apple juice, the analysis of which showed a sp. gr. of 1·021, an acidity of 0·43, and a pectin content of 1·30 per cent. Using this juice, different quantities of sugar from 2 to 11 lbs. per gallon were used, and it was seen that the jelly became more delicate and sweeter as the amount of sugar increased. The lot containing 5 lb. was selected as being the best in "texture," and that with 6 lbs. as being superior in flavour. Assuming the proportion of 1·25 per cent. of pectin and 5 lbs. of sugar per gallon, the following table which can be applied to an apple juice has been worked out:—

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[1] Some particulars of this apparatus will be given in a future number.

[2] See *I.S.J.*, 1919, 250. [3] *I.S.J.*, 1919, 309.

[4] One American gallon = 0·832 Imperial gallon.

Pectin Per Cent.	Sugar Per Gallon of Apple Juice	
	lbs.	oz.
0·50	2·0	—
0·60	2·0	6·4
0·70	2·0	12·8
0·80	3·0	3·2
0·90	3·0	9·6
1·00	4·0	—
1·10	4·0	6·4
1·20	4·0	12·8
1·25	5·0	—
1·30	5·0	3·2
1·40	5·0	9·6
1·50	6·0	—
1·60	6·0	6·4
1·70	6·0	12·8
1·80	7.0	3·2
1·90	7·0	9·6
2·00	8·0	—
2·50	10·0	—
3·00	12·0	—

In the case of juice made from apple pomace, it has been noticed that the proportion of sugar to be added is 1 lb. for every degree Brix, a fine, clear jelly thus being obtained, which is firm and will stand up under almost any climatic conditions. A more delicate jelly can be made by increasing the sugar to 1·25 lb. per degree Brix.

Determination of Pectin in Apple Juice, etc. *C. H. Campbell.* *Journal of Industrial and Engineering Chemistry, 1920, 12, No. 6, 559.*

In the procedure followed by the author, 10 c.c. of the juice are added drop by drop to 180 c.c. of alcohol, the precipitate filtered off immediately through a Gooch crucible, redissolved in boiling distilled water, evaporated to dryness, heated for two hours at 70° C. *in vacuo*, weighed, ashed, and finally re-weighed. A rough indication of the amount and quality of the pectin present may be obtained by observing the precipitation as 10 c.c. of the juice is slowly run into 150 to 180 c.c. of alcohol. When the pectin amounts to over 1 per cent., it will gather in a cohesive gummy mass, but if the amount is less, the precipitate is flocculent.

Determination of Sucrose and Raffinose by Hydrolysis with Organic Acids. *E. Hildt.* *Annales de Chimie analytique, 1920, 2, No. 4, 103-106.*

Benzene sulphonic and phenol sulphonic acids are recommended for the hydrolysis of di- and tri-saccharides, on the ground that they are less energetic than mineral acids, and that their action can be more readily controlled, either by the amount used or by the duration and degree of heating.[1] Thus, using 20 c.c. of a normal solution of benzene sulphonic acid, a solution of sucrose can be completely inverted at 85-100° C. in 45 minutes. A solution of raffinose under the same conditions may be hydrolysed to levulose and melibiose in 75 minutes, and completely to dextrose, levulose, and galactose in 8-10 hours. During the complete hydrolysis of the tri-saccharide under these conditions, the rotatory power of the levulose gradually diminishes, but its reducing power is stated to remain unaffected. It is therefore suggested that raffinose may be determined in the presence of sucrose by ascertaining the cupric reducing power of a solution at two stages, firstly when the sucrose is wholly hydrolysed, and the raffinose partially (i.e., to levulose and melibiose), and finally when the tri-saccharide is completely transformed to dextrose, levulose, and galactose.

Mottling (Mosaic) or Yellow Stripe Disease of Sugar Cane. *John A. Stevenson.* *Journal of the Department of Agriculture (P.R.)*, 1919, *4*, No. 1, 1-76.

This is a comprehensive general account of the nature, symptoms, effects, and control of the mottling or mosaic disease, illustrated very fully by plates, some of which are coloured. "Control lies in the use of disease-free seed, and the elimination of deceased cane, either by ploughing badly attacked fields, or by digging out diseased stools. The more resistant varieties should be used to the exclusion of the very susceptible types, and continued search should be made for varieties still more resistant, or even immune."

J. P. O.

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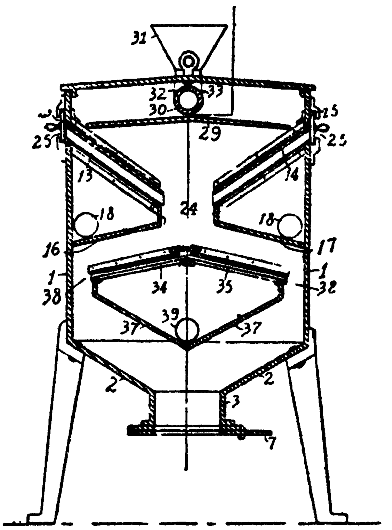
[1] E. Hildt, *Comptes rendus*, *1918*, *167*, *756-769*.

Review of Recent Patents.[1]

UNITED STATES.

Filtering Apparatus for Cane Juice. *Juan M. Izquierdo*, of Habana, Cuba. *1,337,517*. December 10th, 1918; April 20th, 1920. (Two figures).

This apparatus is essentially composed of a series of inclined filtering surfaces arranged one over the other in such a way that a portion of the liquid which does not pass through the upper filtering surface falls on one below, a continuous effect thus being obtained, taking advantage of the action of gravity. Arrangements are provided by means of which the filtering surfaces can easily be cleaned and substituted.[2]



Referring to the figure, the liquid to be filtered, e.g., defected juice, is introduced into the pipe *30* through the funnel *31*, whereupon it leaves the pipe through the slots *32* and *33*, and falls upon the inclined portions of the partition *29*. It is thus directed on the upper filtering surfaces *13* and *14*, composed of two frames of wire gauze. The major portion of the liquid percolates through and is deposited in the receptacles *16* and *17*, from whence it is discharged through the pipes *18*, *18*. That portion of the liquid which does not pass through the surfaces *13* and *14* falls through the central bottom space *24* upon the surfaces *34* and *35*, which likewise consist of two frames of wire gauze. The liquid is filtered and is discharged into the receptacle *37*, and is directed to the discharge pipe *39*. Any liquid which does not pass into the receptacle *37* falls through the spaces *38* and is collected in the bottom *2*, where it may be discharged by opening the hatch 7.

When it is desired to clean the filtering surfaces *13* and *14*, it is only necessary to move the hatch *25*, so as to uncover the opening, whereby a brush may be inserted into a box and the wire gauze thoroughly cleaned. The frames are readily withdrawn through openings, so that they may be removed, cleaned and replaced. Filtering frames *34* and *35* are similarly removable through openings formed in the wall of the apparatus.

Self-discharging Centrifugal. *Angus H. Gibson*, of Salt Lake City, Utah, U.S.A. *1,336,779*. April 21st, 1915 (renewed June 25th, 1919); April 13th, 1920. (Three figures).

It is intended to provide a convenient and efficient construction by which the sugar accumulated on the interior of the basket may be quickly discharged by the automatic operation of the machine after each charge has been washed in the usual manner. It comprises the combination with the rotary basket and its shaft of a vertically movable bottom connected with actuating mechanism by which the bottom is lowered automatically by the slowing down of the machine.

The centrifugal basket comprises the perforated cylindrical wall *b* properly reinforced and secured at its lower end to a strong ring b^2 which is preferably cast integrally with the supporting spider b^8 which is provided with concentrically arranged upwardly extending supporting arms b^4 between which are left large peripheral openings for the escape of the sugar outwardly when it is discharged from the basket. The spider has a central hub b^5 by which it is rigidly secured to the lower end of the shaft *a*. The basket has the usual top rim b^6, but its lower end is open and is normally closed during the operation of the machine by a vertically movable circular plate or bottom *c* provided with a depending rabbéted flange *c'*, which makes a tight joint with the lower edge portion of the basket when in raised or closed position. The movable bottom *c* is connected by means of a cone or spider c^3 with a supporting and actuating sleeve c^2 which surrounds the basket shaft *a*, said sleeve c^2 being provided with an external screw-thread.

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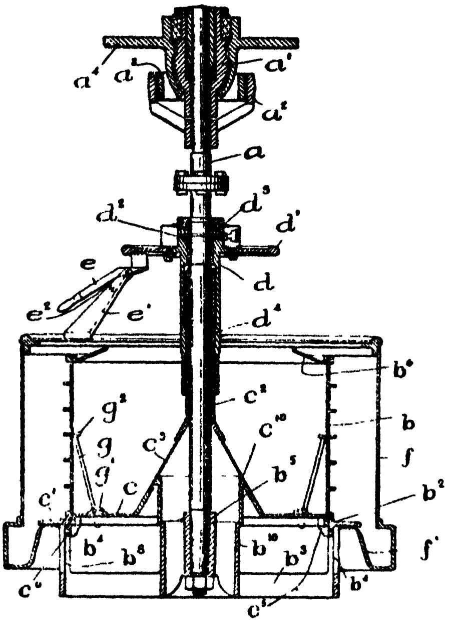
[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 2fr. 00 each).

[2] Compare, U.S. Patent, 1,332,877; *I.S.J.*, 1920, 416.

The raising and lowering member herein shown comprises a sleeve *d* provided with a weighted or momentum wheel *d'* and mounted upon a thrust or bearing collar d^2 secured to the shaft so as to permit rotative movement of the sleeve *d* in relation to the basket shaft. An anti-friction thrust bearing, as shown at d^3, may be used to diminish friction. The sleeve *d* is internally screw-threaded, as shown at d^4, to engage the exterior thread on the bottom supporting sleeve c^2. These engaging screw-threads of the actuating member *d* and the supporting sleeve c^2 are so formed that in starting the machine in operation, any tendency on the part of members *d*, *d'* to lag behind the shaft serves to raise the sleeve c^2 and the movable bottom *c* and so that when the brake is applied to the shaft *a*, the momentum of the bottom actuating member *d* causes said member to continue its rotation at a higher speed than the rotation of the basket shaft when slowed down by the brake, and therefore depresses or lowers the movable bottom *c* to its lowermost position below the peripheral openings in the spider b^8, b^4.



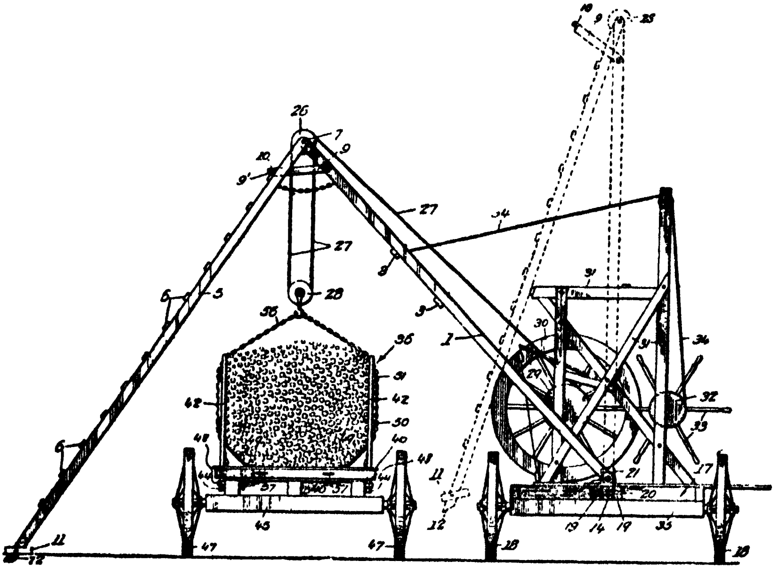
After the basket has been emptied while the machine is being brought up to normal speed a brake *e* mounted on a bracket *e'* above the curb *f* is pushed into braking engagement with the wheel *d'* so as to retard the sleeve *d* in relation to the basket shaft, and thereby raise the bottom *c* into its uppermost or closing position. This brake is normally kept out of engagement with the wheel *d'* by a spring e^2. In order to assist in guiding the movable bottom, inwardly projecting ribs b^8 are provided on the spider arms b^4; and on the under-side of the bottom *c* at its periphery are secured a series of brackets c^5, each carrying a pair of slightly-spaced anti-friction rollers c^6, arranged to engage the opposite faces of the guide rib b^8. The conical connexion spider c^3 may also be provided with a downwardly extending tubular collar c^{10}, engaging the upward extending cylindrical portion b^{10} of the spider hub to serve as centralizing guiding means to prevent the sleeve c^2 from binding upon the basket shaft. These anti-friction rollers serve to prevent any binding engagement between the movable bottom and the basket spider, while at the same time securing their rotation in perfect unison. To assist in breaking down the walled-up sugar when the bottom is lowered, a series of hooked-arms *g* is provided, which are pivotally connected with brackets *g'* secured to the bottom *c*. The hooks or heads g^2 at

the upper end are embedded in the sugar wall, and act as a sort of hoe to pull down the sugar when the bottom is lowered. The sugar-engaging members will remain normally against the peripheral wall of the basket owing to the centrifugal force, and are prevented from falling inward by angularly projecting feet. The curb basket *f* is provided with an annular trough *f'* in position to catch the extracted syrup which flows down outside the flange ring b^2. The inner wall of this trough is also positioned to throw the sugar downward into a hopper beneath the curb.

TRANSPORTING HARVESTED CANE. *Eugène de Boyrie*, **of Ermita, Cuba.** *1,341,042.* **March 22nd, 1919; May 25th, 1920. (Two figures.)**

Objects of the invention are *inter alia* the convenient loading and unloading of the cane truck; the provision of a derrick which can be readily placed in a functional position with respect to a loaded crate; and the transport of the derrick on a wagon for placing in the location desired.

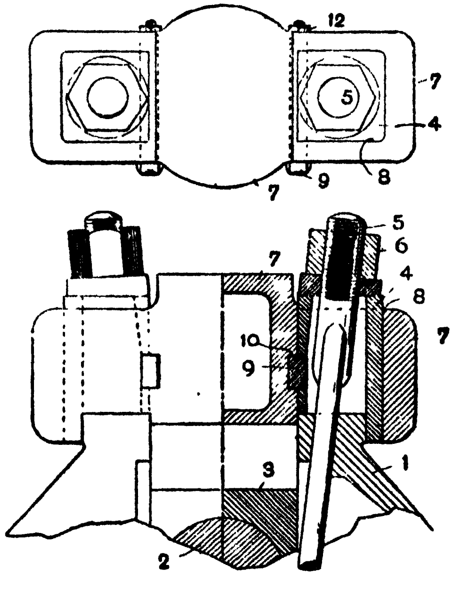
The portable crate *36* is placed on the ground near the cut cane which is packed longitudinally into it, and carried by the transverse beams *40*. The cane is placed in layers until the crate is filled to the top of the stakes *42*, after which the truck carrying the tripod is arranged adjacent to the crate; thereupon the drum *32* is actuated by means of the pilot-wheel *33* to pay out the cable *34*, so that the tripod is placed from the position shown in dotted lines to that shown in solid line. The point *12* of the tripod shoe *11* is forced into the ground so as to impart stability to the hoisting apparatus. Subsequently the tripod is arranged such that the beam *14* is in horizontal position, this being indicated by a water level arranged on the beam. Bolts serve to lock the longitudinal beam in adjusted position. After the tripod has been set for operation, the drum *29* is actuated to pay out the cable *27* whereby the hoisting apparatus is sufficiently lowered to permit the chains *56* to be secured to the bail members or hooks of the crate. The crate is then raised by the proper rotation of the drum *29*, and is maintained in raised position until the truck *45* is arranged underneath the basket in the position to receive the crate *36* when the latter is lowered so that the corner stakes *44* enter the bail members *48*, extending laterally from the platform *46* of the truck. The hooks of the chains *56* are then detached from the bail members of the basket, and the hoisting apparatus *28* is again raised so as to clear the basket.



The vehicle *45* can then depart with a loaded basket *36* to the factory or other place of destination. The crate *36* having been disposed of in the manner described it becomes necessary to move the truck carrying the tripod to another place where another loaded basket awaits removal. The point *12* of the legs *5* of the tripod is withdrawn from the ground by means of winding up the cable *34* and in the further winding up of the cable the legs *5* will approach the legs *2* as indicated in dotted outline. The vehicle together with the derrick is then drawn to some other place where a loaded basket is ready for transportation, and when this position has been reached the tripod may be opened and lowered to insert the point *12* into the ground to stabilize the tripod. The previously described operation of raising the crate and placing another truck underneath the same is next repeated. When a vehicle which has transported a loaded basket to the place of destination returns, the empty basket is removed by seizing the handles 57 and lifting it therefrom on to the ground, thus being ready for renewed loading.

Top Cap for Mill Housings. *Jesse I. Boyer,* of Reading, Pa., U.S.A. *1,344,287.* September 23rd, 1919; June 22nd, 1920. (Two figures.)

According to U.S. Patent No. 976,144 of November 22nd, 1910, the removal of the top cap could only be accomplished after the king bolts were removed, which operation is tedious and laborious; but in the present invention the king bolts are provided with supports, independent of the cap, and the cap is secured by means of keys. In order to remove the cap, it is only necessary to remove the keys holding it, when it will be found to be free for lifting from its position on the housing.



Turning to the illustrations, *1* designates the upper extremity of a housing for the rolls and bearings, *2* designates the upper roll and *3* the top bearing therefor, *4* designates the supports for the king bolts *5* which pass through the supports and through the cap, and which are provided with the usual nuts *6*; *7* designates the cap which is formed with two substantially rectangular openings extending there through, one on either side of the vertical centre, and which fit over the supports for the king bolts, and permit the cap to rest upon the upper edge of the housing. At *9* is designated a pair of keys, adapted to fit in key ways *10*, one half of which key ways is formed in the cap and the other half in the king bolt supports, so that, when the cap is in position as shown, the keys will securely hold the parts in their relatively proper positions.

When, therefore, it is desired to remove the cap, for the purpose of removing the top roll and its top bearings, indicated by the numerals *2* and *3*, it will be necessary to merely remove the two keys and the cap may be lifted vertically from its position, thus allowing access to the said top roll and bearings. The keys are preferably of uniform thickness and width,.and are provided with nuts *12* for securing them against accidental removal. It will be noted, therefore, that by means of this simple structure, it is possible to easily and rapidly remove the top cap, the upper roll and the upper bearings without interfering in any manner with the king bolts, and that while the removal of these parts is being accomplished the entire structure, other than the parts named, will remain intact.

UNITED KINGDOM.

Manufacture of Glucose (Fermentable Sugars) from Cellulose. *H. Terrisse and M. Levy*, of Geneva, Switzerland. *143,212* (*12,609*). May 6th, 1920; convention date, May 13th, 1919; *not yet accepted.*

One part of wood is dried, treated with 1–2 parts of 35 per cent. hydrochloric acid, and supersaturated with gaseous hydrochloric acid until the acid concentration reaches 41 per cent., the temperature being maintained between 0 and 25° C. The mass is allowed to digest at a slightly higher temperature, and the excess of acid is removed, the liquid containing the " glucose " being finally filtered off, and concentrated *in vacuo*.

Roasting Cocoa Beans. *M. Pannevis*, of Utrecht, Holland. *143,224* (*12,956*). May 10th, 1920; convention date, February 1st, 1919; *not yet accepted.*

Cocoa beans and the like are roasted in receptacles heated by a surrounding liquid, such as glycerin, which is maintained at or near its boiling point.

Boiling Pans for Confectioners. *J. M. and T. F. Murray and J. G. Steven*, of Glasgow, N.B. *143,424* (*17,292*). July 10th, 1919.

The liner of a stove for heating sugar boiling pans is constructed in the form of an inverted frustrum of a cone, and is surrounded by refractory material, the whole being enclosed by a sheet-metal casing internally lined with asbestos.

Filter-Press Plates. *W. Buckley*, of Chicago, U.S.A. *143,478* (*32,332*). December 24th, 1919.

The plates of a filter-press are so formed that the cakes are produced in a number of separate portions. For this purpose the straining plates which carry the filter-cloth are formed with a number of corrugations, preferably radiating from the central feed opening, the corrugations of adjoining plates touching each other, these corrugations being sloped off at their ends to make a tight joint with the central flanges of the plates.

Self-balancing Centrifugal. *William McChesney*, of Acton, London. *142,949*, (*4367*). February 21st, 1919; May 20th, 1920. (Three figures.)

Claim is made for a centrifugal basket in which the lower portions are made heavy, the basket being so mounted on a fixed column that the point of support is situated between the top and bottom, and the mounting being so constructed that any oscillations are taken up by flexible buffers on the mounting.

Suppression of Froth when Boiling Liquids. *Elias Wirth-Frey and Ernst Jenny-Henz*, both of Aarau, Switzerland. *121,293* (20,169). December 5th, 1918; June 7th, 1920. (One figure.)

Hitherto attempts to remove or prevent the formation of froth have involved the use at a certain height above the level of the liquid of a rapidly rotating vane wheel or rotating drum, but the construction of such devices has been such that the froth has been apt to close over the same, and the value of the surface space cleared by the device is small. In contradistinction to these means, the present invention consists in so arranging heaters that they extend upwardly to such a height that an open space is maintained above the liquid, communicating with the free air space of the evaporator, the total hollow surface thus formed being several times greater than the free surface of the liquid.

Filter-Press. *F. K. and E. F. Atkins*, of Harrison, New Jersey, U.S.A. *139,991* (*17,069*). July 8th, 1919;

Plough-like members, operating in the manner of a lathe tool, are used to break up and remove cakes formed under pressure between spaced filter-plates.

MACHINE FOR HARVESTING AND WINDROWING CANE. *Henry O. Scranton*, of Jeanerette, Iberia, La., U.S.A. *144,904* (*18,113*). July 21st, 1919; June 24th, 1920. (Four figures.)

The machine comprises a truck mounted on wheels and capable of being drawn or propelled along the space between two rows of canes. A motor, as a gasolene engine, is mounted on the truck, together with cutting mechanism operatively connected with the motor. This cutting mechanism preferably comprises two circular saws, arranged one on each side of the truck, and adapted to cut down two rows of cane simultaneously. In the case of a small machine, a single saw can be used to cut one row of cane, and various other duplicate devices can also be provided singly. Each saw is arranged to cut off the cane close to the ground; and it is mounted in a vertically adjustable frame, slidable in guides, secured to the truck.

The windrowing devices are mounted on a separate frame which is provided to the rear end of the truck, and this frame has means for supporting its rear end portion from the ground, such as caster wheels. Curved and converging guides are mounted on the windrowing frame, and their middle and rear parts are shaped something like the mold board of a plough, having flat bottom plates at their bases. The front end portions of the guides project in front of the bottom plates, and are arranged over the saw guards of the saws. The canes when cut fall rearwardly between the guides and are deposited longitudinally in the middle part of the space between the two rows.

The windrowing frame is provided with means for raising its caster wheels clear of the ground so that the machine can be turned around with facility. In order to ensure the canes falling rearwardly against the converging guides of the windrower frame, spider wheels provided with curved arms are mounted on the truck above the saws, and are revolved by suitable driving mechanism. These spider-wheels engage with the top end portion of the canes, and tilt them rearwardly when cut off with the saws. The top portions of the cane slide down the curved guides, and spiral conveyors are mounted on the windrower frame for moving the lower end portions of the cane laterally towards the centre line of draft. These spiral conveyors are revolved by any suitable driving devices from the motor on the truck.

UNITED KINGDOM COMPLETE SPECIFICATIONS ACCEPTED.

MANUFACTURE OF GLYCERIN FROM SUGAR. *Vereinigte Chemische Werke Akt.-Ges.* *138,331* (*1977*). June 18th, 1917.

CUTTING ORANGES OR OTHER FRUIT. *A. W. Maconochie.* *148,030* (*14,420*). June 6th, 1919.

ROASTING COCOA. *L. A. Levy.* *148,082* (*25,691*). October 20th, 1919.

AGEING SPIRITS. *A. Jarraud.* *141,687* (*9321*). April 17th, 1919.

JELLY OR MARMALADE MANUFACTURE. *O. and C. Beilmann.* *147,838* (*19,887*). November 24th, 1916. *148,407* (*20,352*). March 14th, 1919.

TUBULAR EVAPORATING APPARATUS. *E. Barbet et Fils et Cie.* *117,070* (*8821*); addition to *114,838*. June 21st, 1917.

CENTRIFUGALS. *P. T. Sharples.* *148,753* (*18,472*). July 30th, 1919.

REGULATING THE EFFICIENCY OF BOILERS. *C. A. Hubert.* *148,394* (*20,331*). June 20th, 1918.

BOILING PANS FOR CONFECTIONERY. *R. S. and T. N McColl and T. F. Dryden.* *149,172* (*30,772*). December 9th, 1919.

MANUFACTURE OF $(C_6H_{10}O_5)_n$ CARBOHYDRATES. *L. Lilienfeld.* *149,320* (*13,568*). August 6th, 1919.

EVAPORATORS. *E. Babcock.* *148,836*; *148,837* (*20,513*; *20,514*). April 14th, 1917.

FILTERS. *R. Wuster.* *148,993* (*20,888*). March 16th, 1918.

CANE MILLS. *F. J. de Bruin.* *149,289* (*21,403*). July 15th, 1919.

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

	One Month ending August 31st.		Eight Months ending August 31st.	
	1919. Tons.	1920. Tons.	1919. Tons.	1920. Tons.
Unrefined Sugars.				
Russia	....	....	....	....
Germany	....	....	....	5,964
Netherlands	....	....	1	....
Belgium	....	....	....	....
France	....	....	....	....
Austria	....	....	....	....
Java	19,332	10,952	146,000	24,429
Philippine Islands	....	....	1,738	....
Cuba	35,367	20,592	417,680	506,325
Dutch Guiana	111	....	1,252	59
Hayti and San Domingo	....	....	....	....
Mexico	....	....	....	....
Peru	6,145	4,209	38,524	29,007
Brazil	....	120	4,220	6,199
Mauritius	15,053	960	114,606	102,493
British India	2,321	974	2,531	15,095
Straits Settlements	....	....	....	....
British West Indies, British Guiana & British Honduras	7,234	5,182	90,406	119,202
Other Countries	916	1,503	11,382	28,929
Total Raw Sugars	**86,479**	**44,492**	**828,340**	**837,702**
Refined Sugars.				
Russia	....	....	....	....
Germany	....	....	....	126
Netherlands	2,554	2	9,355	1,074
Belgium	266	83	2,620	2,041
France	....	2	23	23
Austria and Hungary	....	....	....	123
Java	12,663	....	74,124	5,011
United States of America	969	10,688	143,221	98,700
Argentine Republic	....	7	8	35
Mauritius	409	....	16,277	....
Other Countries	10,837	103	45,699	7,649
Total Refined Sugars	**27,698**	**10,885**	**291,327**	**114,682**
Molasses	4,690	7,371	71,075	55,828
Total Imports	**118,867**	**62,748**	**1,190,742**	**1,008,212**

EXPORTS.

	Tons.	Tons.	Tons.	Tons.
British Refined Sugars.				
Denmark	....	....	....	....
Netherlands	....	....	....	2
Portugal, Azores, and Madeira	....	....	....	....
Italy	....	....	....	....
Canada	....	....	1	....
Other Countries	265	262	869	526
	265	262	870	528
Foreign & Colonial Sugars.				
Refined and Candy	1,467	1,280	1,703	2,148
Unrefined	7,018	1,276	20,161	6,931
Various Mixed in Bond	....	....	....	....
Molasses	1,328	86	4,008	2,610
Total Exports	**10,078**	**2,904**	**26,742**	**12,217**

Weights calculated to the nearest ton.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1920. Tons.		1919. Tons.
Total Receipts January 1st to August 26th	2,361,558	..	2,075,468
Deliveries ,, ,, ...	2,359,534	..	2,071,468
Meltings by Refiners ,, ,, ...	1,993,735	..	2,014,000
Exports of Refined ,, ,, ...	325,000	..	310,000
Importers' Stocks, August 25th	2,024	..	4,000
Total Stocks, August 25th	131,990	..	72,958
	1919.		1918.
Total Consumption for twelve months	4,067,671	..	3,495,606

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1917-1918, 1918-1919, AND 1919-1920.

(Tons of 2,240 lbs.)	1917-18 Tons.		1918-19. Tons.		1919-20. Tons.
Exports	2,301,372	..	2,457,149	..	2,988,988
Stocks	719,703	..	1,024,139	..	383,868
	3,021,075		3,481,288		3,372,856
Local Consumption	68,700	..	60,000	..	55,700
Receipts at Ports to July 31st	3,089,775	..	3,541,288	..	3,428,556

Havana, July 31st, 1920. J. GUMA.—L. MEJER.

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR EIGHT MONTHS ENDING AUGUST 31st, 1913, 1919, 1920.

	IMPORTS.					EXPORTS (Foreign).				
	1913. Tons.		1919. Tons.		1920. Tons.	1913. Tons.		1919. Tons.		1920. Tons.
Refined	605,341	..	291,327	..	114,682	624	..	1,703	..	2,148
Raw	745,680	..	828,340	..	837,702	2,635	..	20,161	..	6,931
Molasses	99,374	..	71,075	..	55,828	321	..	4,008	..	2,610
	1,450,395		1,190,742		1,008,212	3,580		25,872		11,689

	HOME CONSUMPTION.				
	1913. Tons.		1919. Tons.		1920. Tons.
Refined	593,465	..	248,784	..	126,596
Refined (in Bond) in the United Kingdom	487,678	..	547,684	..	532,242
Raw	81,592	..	207,413	..	149,993
Molasses	40,514	..	30,433	..	21,654
Molasses, manufactured (in Bond) in United Kingdom ..	24,224	..	46,911	..	52,457
Total	1,227,473		1,081,225		882,942
Less Exports of British Refined	16,695		870		528
	1,210,778		1,080,355		882,414

Sugar Market Report.

Our last Report was dated 6th July, 1920.

The price for Granulated, Crushed and White Pieces for domestic consumption remains officially unchanged at 112s. per cwt, and the retail price at 1s. 2d. per lb. As from to-day, the maximum at which "free sugar" may be sold, which was reduced to 145s. per cwt. on 12th July and further to 140s. on 9th August, is again reduced to 120s., with a retail limit of 1s. 3d. per lb.; for manufacturing a reduction to 112s. is announced. On and after this date, by the instructions of the Food Controller, W. I. Crystallized and Muscovados imported from the B. W. Indies and Demerara, may be sold retail without reference to, and in excess of, the authorised ration, at prices not exceeding those fixed for "free sugars" by the Royal Commission. An increase in the weekly ration to 12 ozs. per head has been in force since 9th August last.

With a dragging and reluctant market for "free sugars," holders have been willing to meet any small enquiry coming along, at prices substantially below the maximum.

Last week there were sellers of American Granulated at 135s. and Mauritius crystals at 128s. per cwt. spot, duty paid, whilst W. I. Crystallized and Muscovados were nominal and practically unsaleable. It remains to be seen how prices will adjust themselves to to-day's alterations.

We have to record a further development of the decline in values which had already started when our last report was issued, the position in America being the chief contributing factor. The present quotation of 10c. f.o.b., for Cuban Centrifugals shows a decline of 7 c. since that date. In face of the disappointing figures of consumption and the more hopeful new crop prospects, the U.S. market has realised the imprudence of the excited buying which took place a few months ago. Approaching arrivals of purchases from outside sources increased the uneasiness and the desire for liquidation. Speculative operators, as well as legitimate trade purchasers who had adopted the quite unusual course of contracting for private imports, have resold a considerable quantity of White Javas to U.S. refiners, at prices based on a 96 per cent. centrifugal value. The attitude of the banks in restricting facilities for carrying all kinds of produce, only increases the embarrassments of the moment.

Messrs. Willett & Gray's figures of consumption for January/June 1920, compare with the same period of the two preceding years as follows :—

1920	1919	1918
2,207,128	2,120,609	1,915,947 tons

but it is interesting to note that a reliable authority states that the consumption for January/July 1920 was 2,796,000 tons, against 2,788,000 tons in the previous year.

The Java market shows a decline in the period under review, of about 10 guilders, to 51¼ guilders for Whites ready, (equal to 80/9d. per cwt. f.o.b.) Some business has been done to European ports, but prices show considerable irregularity. Generally speaking, parcels afloat nearing their destinations have commanded full prices, whilst lots for shipment have had to compete against offerings for resale by America. September/October shipment to Mediterranean ports is now quoted at about 87/6d. per cwt. c.i.f. It is improbable that the West will get much more from Java than has been already contracted, since Far Eastern markets are denuded by their sales to America, and Japan, China, India, etc. will probably be in a position to absorb not only the unsold balances of the current, but a large proportion of the next crop.

A survey of the outlook at the present time fails to reveal any features which would justify the expectation of an upward movement such as that seen from this time last year onwards. Cuban Centrifugals to-day are 10c. as compared with 6½c. a year ago, and the two biggest consuming countries of the world, America and the U.K., are secure in their supplies for some time to come. In Europe the following increases in production (1920/21) are predicted: Germany 370,000 tons, France 150,000 tons, Czecho-Slovakia 250,000 tons, Belgium and Holland 150,000 tons. It is improbable that Germany will be able to contribute much to other countries, although the Government would favour export if the people would tolerate a continuance of the present meagre ration. After October, Czecho-Slovakian sugars will be available for the Balkans and the Levant, thus relieving the call for Javas from those districts. The expectation of largely increased sowings in Europe for the 1921/22 campaign, and the general tendency the world over to augment supplies, would seem likely to exercise a restraining influence upon speculative enterprise during the coming year.

H. H. Hancock & Co.

10 & 11, Mincing Lane,
London, E.C. 3,
9th September, 1920.

THE

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

Notes and Comments.

The Sugar Situation.

The position in the sugar market the last few months has been an extraordinary one in many respects. Encouraged by the undeniable fact that there was a shortage of sugar in the world, speculators during the first half of this year were scrambling for the available supplies, regardless of price, in the firm belief that they would be able to unload them on a sugar-starved population at remunerative prices. America led the speculative van, and in May last America was the dearest market in the world for sugar, attracting lots from all over the globe which otherwise might have been consumed elsewhere. But the speculators, while right about the consuming capacity of the world at large, proved over-sanguine about its purchasing capacity. They did not take sufficient account of the probably large numbers of the population who while wanting sugar, could not, or would not, afford to pay an excessive price for it. In particular, they misjudged the equanimity of the American public to go on paying prices running up to 36 cents per lb. This latter large body of consumers has revolted and reduced its consumption considerably. The result is that stocks of sugar bought at top prices have accumulated in America—stocks acquired not only from Cuba and the usual American sources, but large parcels attracted to New York from the Far East.

The tightness of money in the States was also against the speculators, as it made it difficult for them to hold on to stocks. The crisis came when shipments of sugars from all parts of the world came to be offered in New York. This was too much for the speculative market, and prices began to fall, till New York, from being the dearest market in May, ended by becoming the cheapest in August. One curious result was that the Far East, which earlier in the year had sold sugars to New York at high prices, started to buy back at a much lower rate. Europe also has been taking advantage of the lower prices to buy further supplies, and has secured some lots at about 11 to 12 cents c. & f., New York. According to Lamborn, about 50,000 tons of Java sugar are believed to have been re-sold either to Europe or to the Far East.

In the United States the domestic supply has been for some weeks in a state of suspended animation. The distributing trade was caught with large stocks of sugar at the earlier high prices, and these have to be unloaded on the consumer, who, however, is buying as little as possible at that price. Gradually, however, these stocks will get exhausted and be replenished by sugar at a cheaper rate, when, of course, retail prices will fall, and consumption will respond by increasing. How many more weeks this adjustment will require appears to be the chief speculation in American distributing circles. Meanwhile the earlier expectations of a bumper consumption this year in the U.S.A. are irretrievably disappointed; Mr. LOWRY, in the *Federal Reporter*, expresses the belief that the 1920 consumption cannot now very well exceed the 1919 figures, which were 4,360,000 long tons, while he estimates that the available supplies will be 4,925,453 tons (3,384,273 tons actual for the first eight months, and an estimate of 1,541,180 tons for the final four months). It is evident then that there will be a surplus left over at the end of the year to carry into the new crop. But the precise amount must depend on the consumption in the States the final three months of the year and on the extent to which other countries buy up the accumulations of sugar held by New York and other dealers. By now the worst of the demoralization of the markets appears to be over, and prices may harden a bit ere coming to rest at a level where prices and supply will meet the mood of the consumer. Whatever happens, we ought never again to return to the abnormal prices of the summer of 1920, unless, indeed, some unlikely catastrophe visited the Cuban sugar industry and reduced the crop by millions. The European beet crop promises well. According to Willett & Gray, it will reach 3,870,000 tons, as compared with 2,676,049 tons last year. But as those statisticians put the German crop at 1,300,000 tons, instead of the more generally credited 1,100,000 tons, it seems hardly likely that the above estimate will be reached. Our Continental correspondent in our June issue put the crop at 3,630,000 tons, and allowing for some increase, which the favourable weather has produced, it seems more likely that the total will be round 3,700,000 tons. Anyhow, there *is* a welcome increase in the European sugar supply, which will go some way to lighten the stringency, and promises well for next year.

The Position in the United Kingdom.

In the United Kingdom, where supplies and prices are controlled, there has been no marked change of late, save that a larger ration has been allowed, as we reported last month, and yellow sugars have been placed on the free list, subject only to the condition that they are not retailed at a higher price than that for "Licenced free sugar" (1s. 3d. per lb.). But white sugars remain at the price, retail, of 1s. 2d. per lb., and one fails to see how the price can be reduced to any marked extent till the Royal Commission have disposed of their stocks bought in the summer at a comparatively high price. It was the misfortune of the Royal Commission that they had to buy up the Mauritius crop at a time when sugar was fetching £130 per ton in the United States. Hence at the time the price of £90 per ton was no excessive one. Unfortunately, the purchase represented 200,000 tons, or say ten weeks' consumption. We shall probably hear a lot the coming autumn from politician critics of the Government about this purchase. We shall be told that the Government are keeping up prices unnecessarily in order to avoid losses on their ill-advised purchases. Doubtless they are keeping up prices; but that is only half the story. It is probably the case, as Sir R. PARK LYLE has pointed out, that by buying this Mauritius sugar when we did and so placing ourselves in an independent position, we deprived the American speculators of an avenue down which to dispose of their excess sugar holdings and so contributed to the slump in prices which now makes the Royal Commission purchases look so expensive. Had we not bought the Mauritius crop, we should have had to seek elsewhere for this quantity of sugar, and it goes without saying that a purchase of that dimensions in American markets would not have caused a slump, but rather have maintained prices at a high level. But we don't suppose the critics will trouble to consider this point.

We notice that the irrepressible Mr. CAIRNS has been lately telling an Aberdeen audience that he had had an offer of 30,000 tons of Austrian sugar at a price which would allow him to retail it at a profit at 6½d. per lb. We take leave to doubt whether the Austrian (or rather Czecho-Slovakian, as we suppose it is) sugar manufacturers would be disposed to part with their sugar at so low a figure, seeing that they can probably sell all they can produce at more profitable prices in France, the Near East, and elsewhere. But even if the incidence of the monetary exchange does allow such a transaction, it only means about ten days' ration for this country. Doubtless the Royal Commission can and does pick up like parcels cheaply, but their task has been something bigger than hunting for small bargains. As a seemingly well-informed correspondent pointed out in the *Times*, the Royal Commission has all along had the difficult duty of supplying the three ports of London, Liverpool, and Glasgow with 20,000 tons of raw sugar per week, and to ensure that they will be provided with a constant supply, not less than 60,000 tons must always be afloat and ready for distribution, and as these 60,000 tons must be paid for before shipment, an immediate outlay of well-nigh £5,000,000 sterling is required, which sum must be constantly in use that 60,000 tons may always be available. It is generally agreed that in present circumstances operations of such magnitude can only be undertaken by a Government Department.

Apart from that, one can gauge the likelihood of sugar being saleable at 6½d. per lb. when, as pointed out by the Royal Commission, the cost of transferring sugar from say America to the retailer's shop in the United Kingdom, including the duty of 2¾d. and the retailer's profit, is at least 5d. per lb. After that there is not much left with which to buy the sugar itself!

Cuba's Independence.

There was a time when the Cuban sugar industry, for lack of capital and warehouses, lived so to speak from hand to mouth, and had to sell her sugar to the refiners at the latter's price and convenience. But the situation has changed completely, and now the Cuban holders of sugar have sufficient funds to enable them to choose their own time for selling if not quite their own price. It might have been supposed that the recent slump in sugar prices and the disclosure of a probable surplus of sugar on the eve of the new Cuban crop, would force the Cuban holders to sell out their balance at a lower price. But as HIMELY reports, the majority of the sugar left unsold in that island is held by the Committee of Mill Owners and Colonos which was appointed to control the price of sugar, and they stick to the belief that the position of sugar will show up more and more strongly as the season advances, and consequently are holding very firmly to their remaining stocks. As new crop Cubas are reported to have been sold at prices equal to if not better than those for old crop sugars, it will not be surprising if the latter are carried over into the new crop. The general attitude of the Cuban holders is that the fall in prices is only temporary, and they count on buyers later on having to pay much higher prices. Whether they are right in their surmise remains to be seen, but it is clear that there is a strong combination in Cuba working to keep up prices, though for obvious reasons some of the American properties on the island are not being encouraged from home quarters to take up this line.

Strike Epidemics.

It is an unfortunate feature of world industry at the present day that efforts to overtake the arrears into which the war has thrown the whole world, are being more or less seriously thwarted by dissatisfaction amongst the workers, which leads in many cases to strikes and such like delays. At home in the United Kingdom one industry after another is passing through a sea of troubles in which periodically repeated demands for wage increases are being made to the employers either direct, or through the Government where the latter has some control over the industry.[1] No one grudges the workers adequate remuneration for their work, but the deciding factor resolves itself more and more into the question whether the workers are prepared to give a good day's work for a good day's pay, or are merely intent on demanding yet higher wages while doing less work than ever. The only satisfactory solution must be in an arrangement of wages which, while ensuring the worker a reasonable minimum to live on, must decide his total pay by the results he produces. A serious coal strike has been threatened in the United Kingdom for some weeks past, in which an unconditional demand for more pay on the part of the men has been turned by the Government along lines wherein the increase will depend on the amount of coal the men produce above a certain datum line of output. This scheme the men's leaders have reluctantly agreed to place before the men and ballot on. At the moment of writing we do not know the result, but it is sincerely to be hoped that this new principle of payment by results may be given a trial by the coal miners, since, if it is successful, it may open the way to an extension in other commanding industries at home, and lead to a much needed increase in production.

We have mentioned the coal strike because it is a key industry, and on it depend the engineering and other industries which, inter alia, provide the sugar industry abroad with their plant and equipment. There is no question but that the industrial troubles of the last two years have greatly impeded the resumption by British engineers of their accustomed part in the provision for abroad of sugar factory plant, and serious delay has been inevitable. The strike a year ago of the iron moulders, which lasted for months, affected English, though not Scotch, engineers to a serious extent. But any prolonged coal strike coming at this stage would be disastrous in the extreme, so it is greatly to be hoped that the saner elements amongst the miners will assert themselves sufficiently to prevent any catastrophe such a stoppage of coal supplies would spell for the country at large.

Apart from home troubles, it is evident that all over the world there is a spirit of unrest amongst workers which will only end in a more or less extensive amelioration of their lot, and as a consequence a proportionately extensive addition to the cost of producing anything, whether sugar or any other indispensable commodity. It is clear to most observers that the low prices which sugar fetched before the war are gone for ever. Java, which was perhaps the example par excellence of sugar produced on a large scale by means of cheap labour, has now got her labour troubles too. Both factory and plantation workers are reported to be in a state of continuous dissatisfaction with their wages and treatment, and are giving in return unsatisfactory service. The result may well be the discouragement of the producer, and a temporary reduction in the sugar acreage. But nothing will be gained by any permanent withdrawal from industry on the part of employers; the economic situation will have to be faced and a

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[1] We may explain here that an unauthorized strike (men coming out in defiance of their leaders) in a section of the printing trade was responsible for delay in the publication of our September issue, which reached our readers some ten days late.

modus vivendi worked for that will satisfy both the employers and the employed. The industrial world has been badly shaken up by the recent war; it will ultimately again come to a state of comparative equilibrium, but clearly not at the pre-war position. For good or evil a new level will have to be struck. We can only express the hope that the good sense of the leaders of industry will result in such a good understanding being ultimately arrived at, that each party will have an inducement to give of its best to the work it is interested in.

Labour in the Fijian Islands.

Following the example set by British Guiana, it would appear that the Fijian Government are taking steps towards the renewal of the immigration of Indian coolies, to which Fiji owes her sugar industry, but which has practically ceased during the last few years. Fiji is a typical Crown Colony, and consists of two large islands, Viti Levu and Vanua Levu, 4500 and 3500 square miles in extent respectively[1], and two or three hundred smaller ones; but, being remote from the main trade routes of the world, we hear comparatively little about it, excepting in the periodic Colonial Office reports. Its claims, however, to closer study are of a high order at the present time. The Islands appear to be ideal for colonization, and, with a slight improvement in certain respects, there is room for a great extension in the production of raw products. Sugar cane, bananas, coconuts and rubber are rapidly becoming staples for export, and rice and maize are increasingly grown, while one of the larger of the minor islands, Taveuni, has established a promising cattle industry. Trade, in both imports and exports, is naturally with Australia and New Zealand. The sugar industry is by far the most important. This is largely due to the enterprise of the Colonial Sugar Refining Company, which commenced operations in the Colony in 1880; already in 1883 over 5000 tons of sugar were exported, and the amount rose steadily, until in 1900 it had reached the respectable total of 80,000. But although this figure has on occasion been exceeded (in one year 120,000 were exported), there would appear at present to be no great prospect of further extension because of shortage of suitable labour. The future of the Colony is closely bound up with increase of labour and improved shipping facilities. The population at present is made up of 4500 Europeans, 90,000 Fijians (who for various reasons are unsatisfactory as labour), 60,000 Indians, 2500 Polynesians, and 3500 half castes. The backbone of the labour on the sugar estates is the Indian element.

When Dr. LUNAN and his colleagues presented the case for the resumption of the immigration of Indian Coolies into British Guiana, to the Colonization Committee at Delhi in February last, the opportunity was taken by the Fijian Government also to approach that body. This was done by an unofficial committee consisting of the Bishop of Polynesia, selected by the planters because of his wide knowledge of the islands and general sympathy with both the natives and the Indian immigrants, and the Hon. Mr. RANKINE, who personally represented the Governor of the Islands. In the report that we have received it is emphasized that the meeting was purely preliminary and informal, and these two gentlemen were unable to offer the cut and dried scheme or to give the guarantees which the British Guiana delegates were empowered to do, but the way to an understanding has been opened, and it is to be hoped that the ultimate results of this first step will be a resumption of Indian immigration into the Pacific, on which the future prosperity of the Fijian Colony so largely depends. They have the advantage of an excellent climate, and a singular freedom from the maladies which have proved so fatal to Asiatic colonists in the past; there appears to be a complete absence of the regrettable racial animosity which is retarding the labour immigration in other places; the wages are good and cost of living small; and while every inducement is offered for Indians to settle permanently in the Colony, by land acquisition or otherwise, there is nothing to prevent them from returning to India with their accumulated savings if they desire to do so. The Islands would indeed appear to be a coolies' paradise, and we shall be interested to see what further steps are taken in the matter in the near future.

The Kelham Beet Sugar Scheme.

The Directors of Home Grown Sugar, Ltd., are now inviting farmers in Nottinghamshire and Lincolnshire to reserve land and prepare it this Autumn for the first crop of sugar beet for the Kelham Factory in 1921. The price offered is £4 per ton of topped beet (tare deducted) delivered at the factory. Already a preliminary list of growers has been secured which includes some of the most prominent and successful farmers in Nottinghamshire and Lincolnshire, and there seems every indication that the first crop of 3000 acres for the factory next year will be secured. In order that growers may have the benefit of the best practical experience available, the Company has obtained the services, as manager of its Contracts Department, of Captain J. H. MOWBRAY, till lately contracts manager to the Dominion Sugar Co., Ontario, Canada, whose three factories deal with the produce of some 30,000 acres annually.

Captain Mowbray will be responsible for the organization of the supply and its delivery to the factory, and the sale and distribution of the by-products to the growers. Apart from the supplies of beet to be grown by farmers, a large acreage will also be grown upon the Kelham Estate under the control and supervision of Mr. SYDNEY COLYER, the estate manager. Seed of the most reliable type has been bought from the leading seed-producing stations in France and Holland, and a preliminary supply of lifting machines of an approved type is being secured for demonstration purposes.

It may be added that now the Kelham project has been taken over by Home Grown Sugar, Ltd., an offshoot of the British Sugar Beet Growers' Society, Ltd., the latter society is being re-organized to be more particularly a society of sugar beet growers all over the country, and to investigate and assist any sound new schemes which may be formulated for the establishment of the industry, although the society consider such a policy cannot be actively pressed forward until the Kelham scheme has proved by experience that commercial success is possible.

Mauritian Investments Abroad.

A correspondent of the *Times Trade Supplement* gives some account of the measures being taken by the Mauritius sugar interests to organize the financing of their sugar sales to the Royal Commission and the advantageous investment of the proceeds. As was the case last year, it has been found impossible for the Mauritius banks to absorb the large sum of money due to the planters from the Royal Commission, and much of that money has been lying to their credit in London banks.

The Syndicate (states this correspondent) which was formed last year for disposing of the whole of the sugar output of Mauritius has been strengthened recently by the addition of the several plantation companies which hitherto had stood aside. At present the Syndicate will only act as the representative of the planters in their dealings with the London Sugar Commission. Proposals have, however,

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[1] Viti Levu is thus somewhat larger than Jamaica (4200 sq. miles).

been mooted for sales to other parties, to be transacted under its control, and it is possible that in due course purchases of machinery and of food supplies for the estates will also come under its supervision, thus eliminating various commissions now paid to a number of intermediaries. A considerable amount of surplus capital belonging to the planters will be available in the course of the next few months for investment abroad. At present the tendency is to develop trade and financial relations with South Africa, particularly with Natal. One leading merchant from Port Louis has transferred his head office to Durban, and two other Mauritian firms have opened branches in that town. Several prominent planters are now visiting South Africa with a view to the purchase of estates and farms there, and Mr. HENRI ROBERT, the statistician of the Mauritius Department of Agriculture, and lately Food Controller of the island, is also travelling in the Union, having been charged with a special mission on behalf of the planting community. Mauritian capitalists are also turning their attention to Uganda, Nyasaland, and Kenya (British East Africa), and investigations have been begun with a view to the purchase of large estates in the latter colony.

The Royal Commission on the Sugar Supply.

Sundry Announcements.

The Ministry of Food issued the following announcement on September 15th last:—

The attention of the Royal Commission on the Sugar Supply has been drawn to sundry notices in the press in regard to the probable course of sugar prices. In one case it has been stated that a retail price of 5d. per lb. might be reached at an early date. In another case it has been asserted that the effect of the recent fall of prices in America cannot be felt in this country for some months "owing to the purchases of the Sugar Commission at the high rates prevailing until recently."

The Commission desires to state that for such suggestions there is no justification whatever. It is quite true that there has recently been a substantial fall in the prices of sugar in the American market, which may be said to be the governing market for a world-price of sugar. But the level to which prices have fallen is even now higher than the price of 1s. 2d. per lb. at which Commission sugar is being sold in this country. The present f.o.b. price in New York of American granulated is about 13 cents per lb. (9d. at present rate of exchange), and at that price such sugar could not be sold here at 1s. 2d. per lb. retail to cover costs, duty, and reasonable trade profits, except under specially favourable conditions. The absurdity of talking of a retail price of 5d. per lb. is manifest when it is stated that the duty on white sugar is 2¾d. per lb.; the cost of bringing sugar from, say America, freight, insurance, landing charges, etc,, is ¾d. per lb., and that it requires at least 1½d. per lb., and often more, to cover the cost of carriage from the docks to the retailer's shop, and a reasonable profit to the latter. These items together amount at the lowest to 5d. per lb., and would leave nothing wherewith to purchase the sugar itself.

As regards the influence of the Commission's purchases on prices in this country, it may be pointed out that from the first the Commission has never regulated its selling prices in immediate correspondence with its own costs; and that for some time past it has been fixing for each four-weekly period a selling price to manufacturers, equivalent as nearly as may be to the contemporary world's price of sugar as determined by the prices in the American market. Thus during the current four weekly period, beginning on Sept. 6, the price to manufacturers of white sugar is 112s. per cwt., which is practically the equivalent of 1s. 2d. per lb. retail for grocery sugar, after allowing for the extra cost of distribution in the case of this latter sugar. As a matter of fact the Commission has, for a long time past, been supplying the people of this country with sugar at prices very considerably less than those at which the sugar could be replaced. Throughout the past eight months of inflated and fluctuating prices in America, sugar has been sold here at uniform prices, always well below what it would have cost at the time to buy, and is still so being sold, nothwithstanding the recent slump in the American market. This surely provides a sufficient answer to the suggestion that the high cost of the Commission's purchases is depriving this country of the benefit of the fall in prices.

The revised sugar prices for *Period, 4th October to 30th October, 1920,* as fixed by the Royal Commission, are :—

	CLASS.	FOR GROCERY PURPOSES. WHITE VOUCHERS ONLY.		FOR MANUFACTURING PURPOSES AND SHIPS' STORES COLOURED VOUCHERS
		Wholesale per cwt. Discount 1¼ per cent. to direct buyers.	Approved retail price per lb.	Wholesale per cwt. Discount 1¼ per cent. to direct buyers.
0.	Castor, Icing, Pulverized ..	118s.	1s. 2¾d.	.. 118s.
1.	Cubes, Loaf Sugar..	116s.	1s. 2½d.	.. 116s.
2.	Granulated, Crystals, Crushed and Chips, Dry White Sugar, White Pieces (moist) . ..	112s.	1s. 2d.	.. 112s.
3.	W. I. Grocery Crystallized Yellow Crystals, W. I. Muscovado (moist), Pieces (other than White W. I. Grocery Syrups)	Free of Voucher Price must not exceed that fixed for Licenced Free Sugar	Free of Ration	Free of Voucher
4.	Jellies, Knots, Lumps, and other Low Grade sugar to be sold only to manufacturers ..	—	—	.. Uncontrolled

The wholesale prices quoted are those at which sugar will be supplied to direct purchasers by the Commission or by refiners.

Wholesale dealers through whose hands sugar passes are entitled to the authorized margin of profit on the net cost and to charge the actual cost of carriage. In addition certain other charges are allowed for handling and storing; and for breaking bulk where the quantity to be delivered is less than that contained in the original package.

Licenced " Free " Sugar.—The maximum " reasonable " price for all licenced " free " sugar from 4th October until 30th October, 1920, has been fixed at :—

Wholesale per cwt. Discount 1¼ per cent.	Retail per lb. for Domestic Preserving only.
120s.	1s. 3d.

The Rumanian sugar industry has not been able to supply the demands of Rumania during the past year; indeed, so little was produced that sugar has become a luxury. The majority of the factories engaged in the making of sugar from beetroot were destroyed by the Germans on the evacuation, and have not yet been put into working order. Machinery is lacking and roots were not cultivated in sufficient quantity by the peasants, even had the factories been able to take the supplies. The reconstruction of this industry is in the hands of a powerful Belgian group, and there is every probability that during the coming year it will be placed upon a more satisfactory basis.

Agricultural Notes.

On substitutes for pen manure.—No excuse is offered for the frequent reference in these notes to various expedients for the improvement of the soil in sugar plantations. When all is said and done the great object in the industry is to increase the yield of sugar per acre, and, with the intensive work done in recent years in factory control and the prevention of all avoidable losses in manufacture, this object will probably be found to be much more easily accomplished by renewed attention in the fields than by further refinements in factory practice; the limits of improvement in the latter are being rapidly reached, while there are admittedly many lines of work on the plantations which have not yet been tackled in a thorough manner. Forcing the ground to produce more cane per acre is, to the writer's mind, the line of least resistance at the present time.

When we consider the vast areas in the tropics where the sugar cane is grown, with their differences in soil and climate, it is obvious that the urgency of improved field work will greatly vary; in some places deep rich layers are available which it may take years to exhaust; and the remarks in this note need not concern the happy owners of such estates, beyond a word of caution that the inevitable years of declining fertility should be delayed as long as possible. But in most places the yield is not what it should be; there may be plenty of plant food in the soil, but, because of some factor in its physical condition, this may not be readily available for the cane plants; in a great many cases there is an ominous threat that the land is becoming exhausted, and that the seven fat years are about to be succeeded by the lean ones. In such cases the need is urgent, and it may be mildly pointed out that, if in the past more careful attention had been paid to the cultivation, the remedy would have proved far more effectual and less costly.

One great difference between the current application of highly concentrated artificial manures and the more slowly acting and more troublesome bulky ones is that the former act rapidly, are soon exhausted, and require constant renewal, while the latter last for quite a number of years before their effect is lost. Careful cultivation, with the addition of reasoned proportions of the various salts needed by the plant in its growth, will do much to keep the land fertile and allow good crops to be taken off for a long time, but, as our knowledge of soil biology becomes more of an exact science, we see that much of the expensive application of artificials' can be cheapened by more fully employing the natural agencies at work which, with careful fostering, will answer the same purpose, and at the same time put a stop to the continual deterioration of all lands relying solely on chemical manures. Nothing in this world can equal the fertility of virgin soil, but that condition has not been reached by any system of manuring, but solely by natural agencies, and, be it noted, concurrently with the growth of enormous crops of trees. Long before the discovery, from the chemical analysis of plant tissues, that it was possible to supply the substances taken from the soil by the addition of certain salts containing the substances in an "available" form, pen manure was known to be a necessity to a successful cropping. And now that artificials have had a long innings, and have greatly improved the mass of the crops obtained, we are beginning to see that the limits of increase in this direction are being reached, and are turning again to the bulky manures, whose value has been perhaps rather eclipsed.

What we now want is not only greater yields but the maintenance of fertility, and for this the concentrated chemical manures are not altogether adapted. And by fertility we do not only mean the presence in the soil of plant food, but the physical condition and conservation of moisture which alone will render these available to the plant. While artificial manures supply the actual food for the crops grown, too little account has sometimes been taken of the adventitious aids to fertility afforded by the unseen bacterial flora. Pen manure, as has so often been demonstrated, is an excellent food both for the crops and their helpers in the soil; but this is not always available, and we must not fold our hands in acquiescence, or lose sight of the necessity of trying to find a substitute. When all the labour in the plantations was done by men and cattle, large herds were kept and carefully tended, and many estates were well supplied with cattle manure for all or for most of their fields. But with the increasing introduction of steam and motor implements, and the taking up of fresh lands where cattle do not exist, this stage is rapidly passing away, and there are at the present day few sugar estates which have enough pen manure to go round.

The sugar planter is sometimes rather limited in his outlook, and has rightly or wrongly taken little pains to study other tropical crops, but much can be learnt from a study of these, especially in the treatment of the soil. In the following notes a broad view is taken, and the most various crops and conditions are laid under contribution, in the hope that while much will be inapplicable to specific estates, some method or substance will in others be found useful. A somewhat detailed list of bulky additions to the soil is given, all of which have been met with by the writer in his tropical work. The use of *oil cake* may be briefly mentioned, although it does not belong to the series; it is largely used in sugar cane work, but in many places apparently has not been sufficiently appreciated; it is rich in plant food (equalling, say, 6-7 per cent. nitrogen and 10 per cent. bone meal), and has the great advantage of only slowly giving up its plant food; it is, however, sufficiently rapid in its action to be available during the life of the cane crop, if sufficient moisture is forthcoming; if there is no rain or irrigation water, it just remains inactive, losing little of its value until the rains come; the consideration of the value for sugar estates of oil cake, which occupies a half-way position between artificial and pen manure, may be conveniently held over to another occasion. So the *green manuring*, which has obtained a great vogue in many sugar-growing countries; it comes better into line with the bulky manures, but is a large subject in itself, and will not be mentioned further here. The addition of decaying vegetable matter from *weed pits* has been dealt with in a previous note[1] and although of great importance, need not detain us. The following apparently unpromising substances will, however, receive attention:—Top soil from jungle, the waste earth under scrub, earth from grass land, burnt earth, tank silt, and various other earths. All of them are used in tropical agriculture with the most beneficial results as to soil fertility in different crops, and it may be well for sugar planters to turn their serious attention to the possibilities of also utilizing them on their plantations. Many will, it is certain, at once scout the idea of adding soil to the sugar lands as too costly, but a careful calculator has estimated that in this respect they have nothing to fear from a comparison with pen manure, and also that some of them are superior to this substance both in immediate and long-continued effect. Much will, of course, depend on the distance of carriage, but it may be noted in passing that the addition of soil to cultivated land in poor physical condition has been shown to render all subsequent operations much simpler, whether in tilling, weeding, or cultivating.

The top soil from high jungle.—This has been found to be of the greatest use in maintaining the fertility of the soil on coffee estates. In a series of careful chemical analyses it has been found to be equal to pen manure in plant food, and where available it is extraordinarily easy to cart and spread. Most planters will of course say that it is out of the question because they have no trees on their estates; but this adds point to the argument recently advanced in this journal in favour of tree-planting on all waste land in sugar cane estates,[1] as is being persistently done in the Hawaiian plantations. Not only is this top soil valuable because of the plant food contained, but its residual action on conservation of moisture is one of its main features. Lightly worked into the soil it enhances the physical condition in a marked degree, feeds the beneficent bacteria and keeps them and the cane plants cool and thriving during the spells of drought. VOELCKER estimated that in samples of good top soil from high forest which he analysed three tons were equal in plant food to two of good European stable manure, and the general cost of application was found to be only half as great.

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[1] *I.S.J.*, 1919, p. 541.

Earth under scrub jungle.—This substance was found by the writer to be of excellent value as a top dressing to alkaline lands in India. He was led to the idea of using it by a discovery as to the value of the soil under Lantana scrub on a pepper farm, and a temporary cessation in the carting of tank silt because of excessive rain was thus made good. The immediate result was that the cultivators around who had been keenly interested in the experiment carted some 8,000 loads on to their own land, and they thus not only enriched these but cleared a good space of this troublesome growth. They afterwards claimed that on poor land thus treated they doubled their crops, whereas when they applied it to good lands it made no appreciable difference in the yield. The cost, as the land was near the farm, worked out at from 1½d. to 2d. per cart load, and the effect was noticeable for several years. The nitrogen content was indeed small, but the presence of organic matter in the roots and vegetable debris, together with the excellent condition of the carted soil, all told in its favour. Similar results were obtained, as has been noted above, from the application of Lantana earth to another crop on ordinary but worn out pepper land, and it is fair to assume that the upper layers of any land under scrub jungle under a fairly good cover would be equally useful.

Earth from grass land.—This is usually comparatively rich in nitrogen, and it is well known that excellent crops can be obtained by merely digging it up and inverting the sods (as in the case of potatoes by the writer); it is full of vegetable matter in the shape of decaying roots and stems, and there must be few estates which cannot easily lay their hands on a supply. The experiment is then well worth trying, especially so if it is decided to improve the fodder crop by sowing some sort of millet, a crop which is content with the minimum of soil nutriment and a modicum of rain during its short period of growth.

Burnt earth.—This is recognised as a valuable means of improving the character of the soil, and is used for widely different crops. A convenient method of application of small quantities is sometimes met with when the burnt earth is scattered mixed with artificial manure. One of its chief features is its retentive power of moisture, and here again it simulates pen manure in its action. It is in its way rather troublesome to prepare, but this has not deterred the natives from frequently employing it. Its effect on the physical condition of the soil is always very marked.

Tank silt.—This is commonly used by the native cultivators throughout the Madras Presidency. They apply it to all sorts of land, and are sometimes willing to cart it for as many as twenty miles. It is usually obtained when no other

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[1] *I.S.J.*, 1920, pp. 131-3.

agricultural work is being carried out, and if the source is moderately near, the cost is small. It relieves alkalinity, enriches the soil, and renders it drought resistant; in large quantities (500-600 cart loads per acre) it permanently improves the land, and of course in tank or pond country it is a very economical practice because it deepens the water-holding holes and causes the supply to last longer.

Besides these substances there are *various earths* which are added to the land in the off seasons. Most of these are retentive of moisture, and some are distinctly hygroscopic, keeping the roots cool and fresh when all other surface roots are dried up; the effect noted in some cases on the plants growing is very marked, and this action is worth bearing in mind. C. A. B.

The Growth of the Sugar Cane.[1]

By C. A. BARBER, C.I.E., Sc.D., F.L.S.

X. CONCLUSION.

In the preceding articles of this series, various aspects of the growth of the sugar cane plant have been passed under review. We have traced the manner in which the seed germinates and forms the young seedling cane and have shown how the planted out set renews the growth of the parent plant, and in both cases we have noted the steps by which the mature bunch of canes is formed. We have dealt with the manner in which this plant, debarred by the absence of a cambial ring from increasing in thickness in a normal manner, builds up the cane thickness appropriate to the variety; and the two stages of growth common to all grasses have been discussed, whereby a foundation is first laid underground, consisting of an intricate network of stems, and when this is completed the end of each shoot thus formed is pushed into the air as a solid cane, often terminating in an inflorescence or arrow which puts a stop to its further elongation. Considerable attention is paid to the first, underground stage of growth, for this has apparently been neglected by former observers, and we have shown by means of dissections and diagrams that the branching system of the cane lends itself to expression by a simple formula, and that such formula, consisting of many terms in the wild species of Saccharum, gradually decrease in length as we pass through the various groups of indigenous Indian canes until, in the ordinary canes of tropical countries, the formula is very short and the intricacy of branching is reduced to a minimum. In a mature plant, it has been shown, not only that the individual canes are branches of various orders, arising in a regular manner after and from one to another, but also that the branches or canes of different orders have very definite characters by which we can at a glance distinguish them from one another. In late or early development, length and thickness of joint, rapidity of growth, ultimate sugar content and other characters, the canes of a plant often differ among themselves more than do the canes of different plants or, indeed, varieties; and this accounts for the well known fact that the cane crop arriving at the mill, even from a uniform field of one variety, often appears to be a very miscellaneous assortment in respect of these characters. We have concluded that it is idle to expect complete equality in such a case, as even in the same plant at crop time some of the canes will be over-ripe, others at their optimum, and yet others as yet unmatured. And we have pointed out that a good deal of work has still to be done before a scientific knowledge can be obtained of the correct time at which each variety should be cut, so as to obtain the maximum of sugar from it in the factory.

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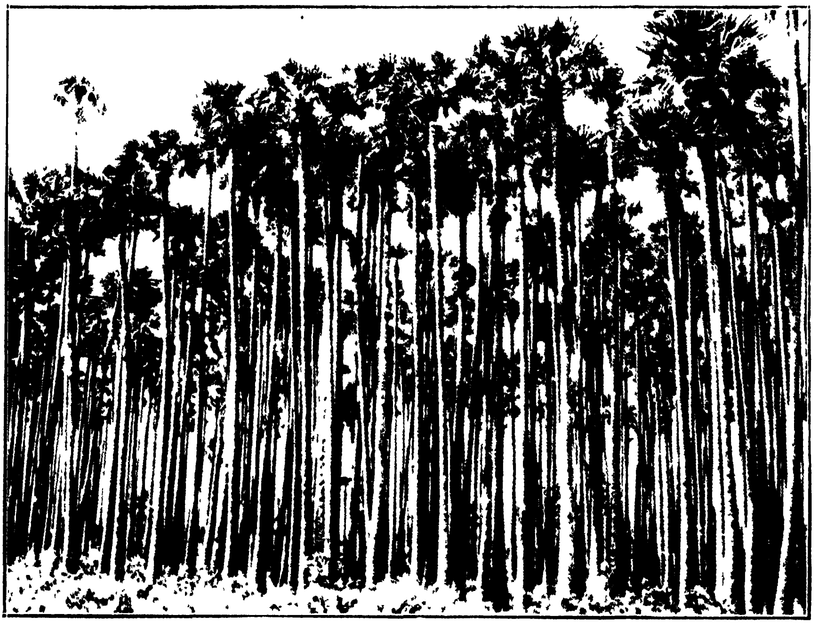
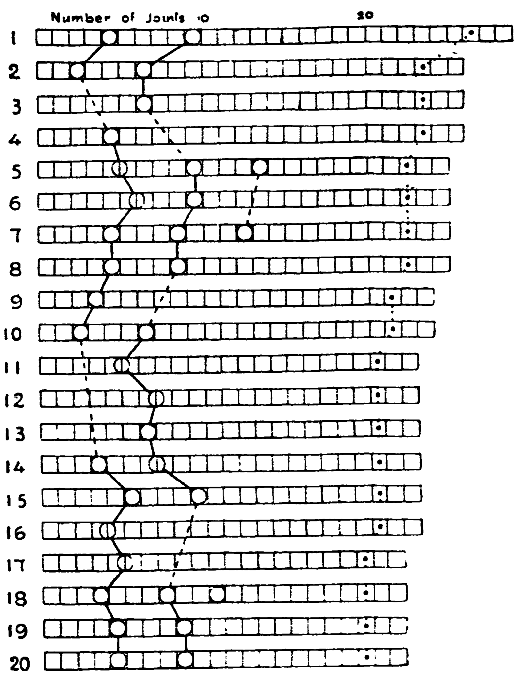
[1] The previous articles of this Series appeared in our issues of October, November, December, 1919, February, April, June, July, August, and September, 1920.

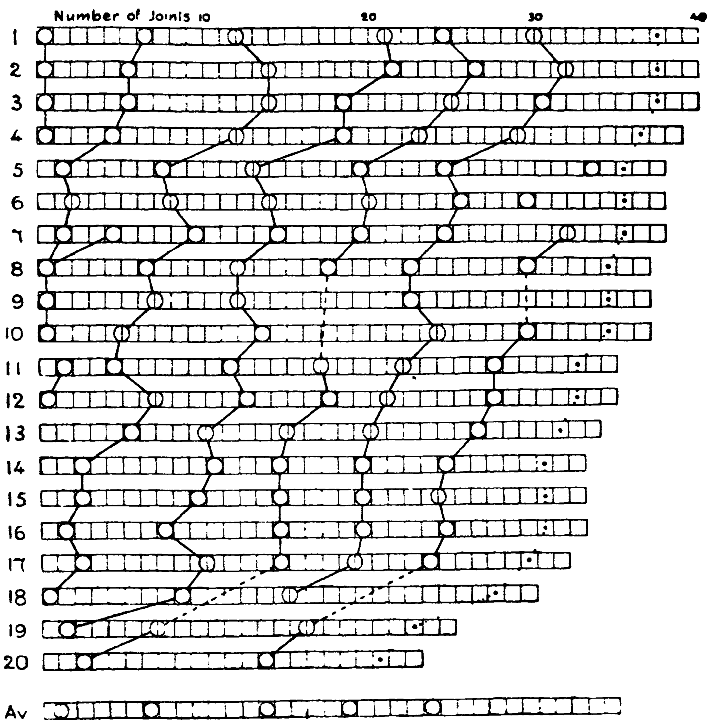


Palmyra Topes in the Madras Presidency.



Pansahi. Wetland Coimbatore. 1914-15.

Fig. 2.



Pansahi. Samalkota. 1915-16.

Fig 1

Periodicity in Maximal Joint Length of Pansahi Canes.

The Growth of the Sugar Cane.

The parts of the cane above ground—leaf, stem and leaf sheath—have been studied as to their growth and the curious fact has been noted that no two of these parts are found to be growing in length at the same time, suggesting that only a certain amount of growing energy is available and that this is switched on to the different organs in succession. The leaf elongates first, and not until it has reached its full length does the leaf sheath extend itself, and this sequence is followed by the stem which only commences to grow in length when the leaf sheath has fully developed. The length and thickness of the mature cane have been studied in different varieties and the effect of external conditions, especially on the latter has been noted; lastly, the whole question of tillering has been dealt with and the results of previous studies on this subject have been summarized. The factors which influence growth in all these directions, which play such a considerable part in the tonnage of canes at harvest, have been analysed, in the hope that by their knowledge the way may be cleared for studies in increased output.

It will be obvious to the student of plant life that there are many other directions in which the growth of the cane could be discussed, and some of these form interesting matter for report and experiment: but it is felt that the present series of articles will have already provided sufficient material for anyone interested in the subject to obtain a fairly clear idea of what goes on in the cane plant, whether in the soil or the air, and of the way in which the plant is built up from its small beginnings, and we have therefore decided to close the series, as such, with the present paper.

At various points in our remarks, glimpses have been given of large series of measurements which have been made of the canes and their parts under the writer's direction, to obtain an insight into the way in which they behave under different conditions. One of the outcomes of this study has been the conviction that no one of the vicissitudes experienced by a plantation during the growing season but leaves its mark permanently engraved on the size and form of the cane and its appendages. This should not appear strange to us when we remember that, by counting the rings of growth in a piece of wood we can form a fairly accurate idea of how long it took to make it and, to some extent, the character of the seasons during its formation. Similarly, by carefully noting the shape and distance apart of the leaf scars in an ordinary shoot, a history of its growth can be compiled for a series of years, the regular succession of spring, summer, autumn and winter, and we can even hazard suggestions as to the severity of mildness of some of these. As an example of quite another "interpretation of observed characters," a couple of photographs are given of palmyra topes in the south of India. In one case the normal growth of a plantation 60-70 years old is shown, while in the other some catastrophe has evidently happened, presumably a wind storm of unusual severity which has bent a number of trees at about the same angle, after which they have recovered their usual upright direction. Careful local enquiries elicited the fact that the storm took place about 28 years before the picture was recorded, because a domestic event of importance occurred in the same year in the narrator's family.[1] This record of experiences during the growing season is also to be found in the stem of the sugar cane, and a new interest has thus been infused into the dry and apparently profitless multiplication of laborious series of measurements undertaken for another purpose. A case has, indeed, been already given[2] in which, by studying abnormalities in the joint curves of the cane in a certain year on the Samalkota

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[1] The illustrations in this article are reproduced by the kind permission of the Inspector General of Agriculture in India. The writer is indebted to Mr. McRae for the photograph here mentioned.

[2] *I.S.J.*, 1920, pp. 374-5

Sugar Station, a ready explanation was found when the details of the weather were looked up in the annual reports on the subject.

When, at the founding of the Cane-breeding Station at Coimbatore, a larger number of North Indian canes were brought into the Madras Presidency, where the conditions are tropical and better suited to thick tropical varieties, it was thought worth while to make observations as to whether the change of climate would cause any observable alteration in the form and size of the organs. And a complicated series of exact measurements were instituted and taken year by year. Seven types were taken for this observation, and these were distributed to other parts of the Madras Presidency, and were subsequently studied wherever they were known to be growing on sugar stations elsewhere in India. Sets of measurements were thus obtained from ten different parts of India, andup on analysis of these it was found that not only had each variety a definite growth character of its own, but that each locality and soil had the power of modifying this, so that the growth in each place was the resultant of the inherent characteristics of the type, and the external environment to which it was subjected.

From the mass of material thus collected at or near harvest time, by trained subordinates in all parts of India, curves of length were prepared of the joints, leaves and leaf sheaths and tables were prepared giving averages of the most various other measurements. From a study of these data it was found to be not difficult to form an idea as to what variety of cane was being measured, and in what part of the country it was being grown. It was an easy step from this position to attempt to form an estimate as to the suitability of a variety to any given place, and also to form a general opinion of the suitability of any place for cane growth generally. This work has been briefly described in a paper by the writer,[1] and it is suggested that by this means a useful method has been devised for the study of cane growth in new tracts of country. It often happens that when the experimental plots extend over a wide stretch of country the task of examining the crops in all of them at harvest time is a severe strain upon the superior staff, and the results are likely to suffer because of this. It is also difficult for an officer rapidly passing through the country to keep rigidly to a uniform standard.. But by relegating the observations to a fixed scheme of measurements by trusted subordinates, not only are these difficulties overcome, but there is a permanent record which may be referred to at any time, and which will be available for any new enquiry not at first comtemplated.

Many points regarding the growth of the cane may be conveniently worked out with such a series of authentic records at hand. As an instance, when the idea of periodicity in the cane growth was suggested by certain curves of the length of joints, it was easy to push the matter further by inspecting the joint curves already worked out, and to add to their number from the table of measurements. It was observed that, in the Pansahi group of canes, many cases were met with in which zones of longish and shortish joints followed one another with some regularity. We have on several occasions in these articles referred to the fact that this group of canes, by the extreme regularity of their growth, have brought out points of general application which have been obscured in other groups of individual irregularities, and the present is no exception to the rule. While it was easy almost in any curve to detect evidence of periodicity in the length of joints in members of the Pansahi group, it was not at all easy in most other cases, but the subject had not been fully gone into when the writer left his work in

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[1] C. A. BARBER, Studies in Indian Sugar Canes, No. 5. Memoirs of the Agricultural Department in India. Botanical Series, X., 3, 1919.

India. Two specially well marked cases are shown in the plate, and the diagrams will require a brief explanation. The whole of the canes measured at one time and place are supposed to be laid down in front of the observer; each joint is represented in the plate by a square, and the longest canes are placed at the top, and those below with successively fewer joints. From our study of early and late canes we know that the former are characterized by having more joints, and the arrangement in the plate thus roughly corresponds with the order of development of the canes. A careful study is then made of the table of measurements of the length of the joints in each cane, and a mark is placed over the middle of any region of longer joints; these marks are represented by circles in the diagram. Lines are then drawn between maxima which are supposed to be related to one another in adjoining canes, and dotted lines are added where no such relation is traceable because of absence of maxima, merely to suggest the completion of the lines from top to bottom of the series. On the right of the diagram a further dotted line gives a general curve of the varying number of joints in the twenty canes, and it is noticeable that there is a strong tendency for the maxima lines to be parallel with these (see in Fig. 1 canes 3 and 4, 7 and 8, 8 and 9, 10 and 11, 12 and 13, 14 and 15), and this tendency has been used to influence the direction of the empirical dotted lines added in the diagram. The diagrams speak for themselves. Taking the most regular cane (No. 7 in Fig. 1) we have well marked maxima in the 2nd, 5th, 10th, 15th, 20th, and between the 32nd and 33rd joints, the maxima occurring at regular intervals excepting at the top and bottom of the cane, when local disturbances might be expected.

Whether the periodicity in growth of the cane thus brought out in the joint curves in Pansahi is due to an inherent periodic stimulus of growth or to some external cause cannot be determined without a full knowledge of the conditions of the crop during its full growth; it is natural to suggest that the explanation may be found in the regular waterings given, but if so, we are at once in difficulties; the waterings are far in excess of the maximal periods at some parts of the year, and are altogether absent during the time of the monsoon rains, and the other groups do not show regular maxima with anything like the same clearness.

A number of leading sugar enterprises, including the Cuban-American Sugar Co., and the National Sugar Refining Co., have formed the Cuban-Santo Domingo Sugar Development Syndicate, which will control mills having an output of close upon 1,000,000 bags a season. Its capital is stated to be $32,000,000.

A cane-planting machine has been invented by Mr. H. C. L. Fossey, of Innisfail, Queensland, and demonstrations giving satisfaction to the growers of that district are reported to have been made. It is stated to open up the drill for the "plants" on the ploughed land; to deposit the plant at the required depth in the drill; and lastly, to cover over the plant with the necessary amount of earth. It is claimed to complete these operations with the labour of four horses and one man driving them.

A Research Laboratory has been established by the Ministry of Agriculture with the object of discovering rat poisons uninjurious to domestic animals, and to improve the poisons already in use.[1] The following recipes among others are recommended: (1) barium carbonate, 6 oz.; meal, 16 oz.; dripping, 4 oz.; and salt, ½ oz., making 1,000 baits of 6 grains (pieces as large as a hazel-nut) each. (2) Squills, red powdered, 20 per cent.; bread, 30; fat, 30; syrup, 20; and aniseed, six drops, the bread being crumbled, the ingredients mixed to a paste, and laid out in pieces the size of a hazel-nut in places where rats are known to be present. When there is no danger to human beings or animals, one of the standardized preparations containing arsenic is generally efficacious.

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[1] *Journal of the Ministry of Agriculture*, 1920, 27, No. 3, 221-224.

The Queensland Cane Sugar Crop.

Official Estimates.

The General Superintendent of the Queensland Bureau of Sugar Experiment Stations (Mr. H. T. Easterby) states that the estimate of the present season's cane crop is about 1,365,000 tons of cane. This should produce about 160,000 tons of raw sugar. Of this amount it is anticipated that 114,000 tons will be made by the mills north of Mackay and 46,000 tons by those mills situate in Mackay and southwards. This great falling off is largely due to the recent severe drought which persisted well into the present year. With the New South Wales production added to the above figures there will be a shortage of at least 100,000 tons of sugar, which will have to be made up by importations, if the consumption of sugar remains at its present level. The outlook for next year is much more promising due to the better price now offering, and large areas of land have been prepared for planting with cane in almost every sugar district, so that there should be a fine crop next year given good climatic conditions.

The production of last year, 1919, was 162,136 tons of raw sugar which was made from 1,258,760 tons of cane. This yield of sugar was much better than was at first anticipated owing to the high commercial sugar content in the cane due partly to the drought. The tons of cane taken to make one ton of sugar were only 7·76, the lowest amount in the history of the industry.

The Cuban Sugar Industry.

General Economic Conditions.

The following is extracted from a report on the General Economic Conditions in Cuba for the half-year ended 30th June, 1920, furnished to the Department of Overseas Trade by the Commercial Secretary to His Majesty's Legation at Havana:—

Owing to the exceptional conditions obtaining in the sugar market, Cuba continues to experience unparalleled prosperity. This condition is reflected in the remarkable expansion not only of the export but also of the import trade. Practically everything in use being imported, including foodstuffs, the imports *per capita* are at present probably among the highest of the countries of the world.

It can now be said that the grinding of cane of the 1919-20 crop has terminated, and it is possible to form an appreciation of the extent and value of same. During the early part of the year it was estimated by experts that the crop might reach even 4,500,000 tons of sugar; as the season advanced, it was seen, however, that this estimate was over sanguine, and subsequent estimates, successively revised, have reduced this striking figure to something in the neighbourhood of 3,650,000 tons. The production in the 1918-19 season amounted to 3,971,594 tons. The principal cause of the lessened production this season has been drought, as over the greater part of the country the rainfall was deficient, particularly during the months when rain is most necessary for cane growth. To a lesser although appreciable extent, damage to cane by fire has contributed to diminish the crop.

The diminished production was soon reflected in the sugar market, as prices gradually rose until they reached 25 cents per lb. f.o.b., an unprecedented figure in the history of the sugar industry. Prices fell subsequently, and during [illegible] month the price was in the neighbourhood of 18 cents per lb. The greater part of the crop, however, was sold at about 6½ cents per lb., but those holding stocks who have not yet sold are holding out wherever possible for higher prices, as it is believed that before the new crop comes on the market at the end of the year, prices may advance still further. At a recent meeting of the Sugar Planters and Millowners Association, a powerful body representative of the sugar industry, it was decided that sales of the unsold portion of the present crop, estimated to amount to between 400,000 and 500,000 tons, should be made through the Association.

The banks, both Cuban and foreign, have advanced large sums on the security of sugar stocks, but while such loans are not as a rule being called in, no further credits are being extended by the banks where the object in view is merely speculative, viz., to enable the owner of the stocks to hold for a rise. American banks have made it known that loan money must be applied to increased production of cane now, and that advances will not be granted to pay for new equipment. The profits made by growers and millowners have, however, been so large that some portion of these may well be applied to mill extensions and improvements. A rumour is current that an association has been formed among the planters to restrict cane cultivation with the view of enhancing the price of sugar, but confirmation of this is difficult to obtain. An American sugar refining company are reported to have bought 50,000 tons of next year's crop for delivery in January at 12 cents per lb. cost and freight.

Numerous very important sales of sugar mills and sugar-bearing lands have taken place, the aggregate sums invested representing many millions of dollars. It is stated that over 60 per cent. of the Cuban sugar industry is now in American hands. American sugar refining interests have been prominent in buying up properties, as they are naturally desirous of assuring for their industry continued supplies of raw material. Hitherto the refining of sugar in Cuba has not been on an important scale, but indications are not wanting that within a comparatively short time important refineries may be established in Cuba. At the time of writing a large refinery is projected at Regla on the further side of Havana harbour.

A few years ago British sugar mill machinery manufacturers supplied the bulk of the equipment for Cuban mills, but now the United States manufacturers occupy the predominant position. A well-known American Iron Works Company announces by advertisement that of the 44,000,000 tons of cane ground in the 1918-1919 crop, more than 28,000,000 tons were ground with their mills and crushers. The present predominance of American manufacturers is due to some extent to conditions created by the war, when British firms were not in a position to supply the equipment, In addition the relation of American finance to the Cuban sugar industry undoubtedly determines to some extent the source of supply of mill equipment. It is satisfactory to note that experienced sugar-mill engineers often express a preference for British-made machinery. Many of the mills now use crude oil instead of coal as fuel, and the electric drive is taking the place of steam. The shortage of supplies of crude oil in the United States is a matter of some concern in Cuba.

Optimism as regards the future is the dominant note in Cuba to-day, and there can be no doubt that so long as the present world scarcity of sugar continues, the Republic which produces the largest quantity of that commodity will continue to be prosperous. In view of the need to restrict credit, however, which is in evidence throughout the world, owing to financial stringency, caution is necessary in judging of the future trade of the country.

The Price of Sugar in the Netherlands.

The price of sugar for household use in Holland has remained remarkably stable for the last six years and has as yet not greatly deviated from the level ruling before the war. In 1913 the average retail price of crystallized refined sugar amounted to 51 cents per kg., equivalent to 4·64d. per lb., but that was a very low figure and under the average of the five years immediately preceding which was 55 cents. The average price in 1914 was 53 cents per kg. or 4·82d. per lb.

In August 1914 the Government allowed 60 per cent. of the sugar to be produced in 1914-15 to be exported, in the certainty that the remaining 40 per cent. of production plus the initial stocks would be amply sufficient for home requirements. The price was fixed at 51·50 guilders per 100 kg. wholesale and at 55 cents per kg., equivalent to 5d. per lb., retail. The relatively low price of the sugar as compared with that in other countries induced the manufacturers of jams, condensed milk, and the like to export much more of their output than in ordinary years, so that the stocks ran low and the value of the exportation certificates had to be reduced to 40 per cent.

In the year 1915-16 the Government seized the entire sugar production and the stocks, and charged a committee with its distribution ; this had the power of exporting the surplus, after the wants of the country had been cared for. As the home sugar crop was not a large one, importation was impossible and the use of sugar in the country was steadily on the increase, because of the scarcity of fats and other articles of diet ; the quantity disposable for exportation was not large, but this notwithstanding, the stocks at the end of the 1915-16 campaign were very small.

The price of sugar could be maintained at the level mentioned above, viz., Fl. 51·50 wholesale and 55 cents per kg. retail, but the supplies were insufficient to allow of an unlimited consumption and therefore the ration of sugar for household use was restricted in August, 1918, to 250 grms., or something over half a lb., per capita and per week, while the industries using sugar as a raw material did not receive more than 50 per cent. of the 1917-18 allowance, which in its turn was no more than half the pre-war quantity. After the cessation of hostilities and the reopening of navigation as soon as the Dutch vessels, temporarily seized by the Allies in virtue of the right of requisition, had been restored to their owners, the supply of foodstuffs became more abundant and the restrictions of the area to be planted with commercial crops (such as sugar beets) were revoked. The home sugar production of Holland for the 1919-20 crop was much better than that in the immediately preceding years and may be taken at 237,000, tons calculated as raw.

The Government saw this at once and raised in August, 1919, the ration of sugar for ordinary use to 350 grms. per week per capita, at the price of 56 cents per kg., while grocers could buy as much sugar as they liked at an additional price of 30 guilders per kg., under condition that they did not charge their customers more than 90 cents per kg. Everyone could therefore purchase his weekly ration of 350 grms. or 12 ozs. at 56 cents and as much as he liked over the ration at 90 cents per kg. The idea was to declare sugar free in September, 1919, and to cease all Government interference with the sugar trade thereafter, but in those days the world's price rose so greatly that if sugar were to be sold in the shops at the equivalent of the world's parity, discontent among the public was feared and for that reason the following measure was formulated:—

A ration of 250 grms. of refined sugar per capita per week is put at the disposal of the public at the price of 60 cents per kg. The public can purchase that ration at the grocer's against one coupon and payment of 15 cents for the 250 grms. The price at the refinery is fixed at 90 guilders per 100 kg., the wholesale dealers may charge 91·25 per 100 kg. for quantities over, and Fl. 91·75 per 100 kg. The retailers sell the sugar at 60 cents per kg. and four coupons, and are allowed to pay for their sugar either in money or in coupons, which are calculated at the price of Fl. 35·75 per 400. They receive therefore for 100 kg. 60 guilders from the public and Fl. 35·75 for the coupons or Fl. 95·75. The sugar over the ration and the sugar for industry costs Fl. 90·0 wholesale and whoever wants to buy over his ration is free to do so and pays the full price of 90 cents plus the profits of the middlemen. Industries using sugar can purchase unlimited amounts at the price of 90 guilders at the refinery. Two months after these prices were enforced, directly it was known that early frosts had decreased the European crops, they were all increased by 4 guilders per 100 kg., but the ration price remained at 60 cents per kg.

During the 1919-20 campaign the Dutch could purchase 250 grms. or 8 ozs. per week per capita at the price of 60 cents per kg., or 5·46d. per lb. and as much as they wanted over their ration at the price of one guilder per kg. or 9·10d. per lb. Sugar for industrial purposes was unlimited and it paid 94 guilders per 100 kg.

It is evident that these measures which supplied the public with a ration corresponding with the consumption of pre-war years far below cost price and further with unlimited amounts over the ration at a price far below world's parity encouraged the sugar consumption to a large extent. The estimates which had served to make the regulations had assumed the sugar consumption of the country inclusive of the sugar exported in sugared articles to be 150,000 tons or 50 per cent. over that of the last year before the war, when sugar was not rationed and everybody could buy to his heart's content. It appears, that in this present campaign no less than 180,000 tons of sugar will have been consumed, or double the amount in 1911. This heavy consumption of cheap sugar upsets to some extent the calculation, as the loss suffered on the ration sugar had to be made good by the profit on the sugar exported which fetches the world's price. Since, however, the home consumption swallows up almost the whole of the stocks and leaves not nearly so much for export as had been anticipated, the profit for the sugar manufacturers is not so good as had been computed at the beginning of the arrangement.

For the 1920-21 campaign the ration of 250 grms. per week will be continued, but at the price of 70 cents per kg., while the price of the free sugar will be maintained at 1 guilder per. kg. The profit of the middlemen will be increased.

The cost price of sugar is calculated at 73 guilders per 100 kg. If sugar was to be sold retail at cost price, it would be 82 to 84 cents per kg., and since the public is accustomed to one of 60, the difference would be too great. Therefore the Minister of Agriculture wishes to fix the retail price of sugar just between the old price and the cost price as a preliminary measure to freeing the sugar trade.

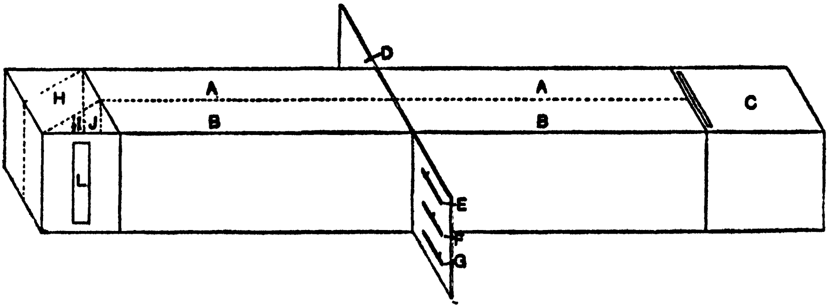
It is known that after September 1921 all interference of Government with sugar prices will cease, so that after that date the price of sugar in Holland will again exclusively depend on the world's parity.

An Improved Method of measuring Colour in the Sugar Factory.

By A. E. BAWTREE, F.R.P.S.

Tintometers have not proved very satisfactory for recording the colour of sugar products. Different colours may give the same reading and conversely the same colour is recorded differently by different observers or even by the same observer on different occasions. The writer has carried out investigations as to the cause of these discrepancies, and finds that they are not due to imperfect construction alone, but perhaps mainly to the incorrect scientific principles upon which the instruments are constructed.

In colour recording successful results are most likely to be secured by following the principles upon which the human eye is constructed. It has long been known that the eye is capable of perceiving three main colour sensations, namely those of violet, green and scarlet light, and that other colours are due to the simultaneous excitation of these three perceptions. Thus magenta is seen by the simultaneous excitation of the nerves conveying the impression of violet and scarlet, blue by the combination of violet and green, and yellow by a similiar combination of scarlet and green. This fact is readily demonstrable by many forms of experiment. For example, if a disc of card be painted in alternate sections of scarlet and green it will appear yellow when rapidly revolved.



The Bawtree Colourmeter,[1] is the practical application of this fundamental principle. The illustration is a diagram of this instrument in which there are two light distributing chambers *A* and *B* illuminated from one source of light contained in the chamber *C*, such as an electric lamp or an incandescent gas burner. The beam of white light issuing from the chamber *A* is adjustable in intensity by a calibrated shutter, contained in the further side of the stage *D*, which reads in direct percentages from 0 to 100. The other chamber *B* contains three transparent screens of the primary colours, scarlet, green, and violet, each of which is provided with a similar shutter *E*, *F* and *G* respectively, graduated from 0 to 100. When these three shutters are fully open, this chamber also passes white light, compounded of the three primary colours, but, owing to the fact that each of the coloured screens only passes a portion of the spectrum, this white light is only as intense as the light passing through the white light chamber *A*, when the shutter is partially closed, say down to 20 per cent. The light from the white light chamber *A* falls upon a white glass screen *H* and that from the colour element chamber *B* falls upon a similar screen *J*, having a broad slot *I* through its centre.

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[1] Manufactured by Messrs. A. W. PENROSE & Co., Ltd., of 109, Farringdon Road, E.C. 1.

An opaque substance under examination is placed over the former screen *H*, while a transparent substance such as a syrup or dye solution is placed in a glass tank mounted between the end of the white light chamber *A* and this screen.

To adjust the instrument, the stage *D*, bearing all the shutters and colour elements, is removed and the source of light in *C* is shifted about until the strip of the screen *H*, seen through the slot *I* in the screen *J* by means of the opening *L* in the instrument case, is identical in intensity with the screen *J*; in other words, the slot completely disappears and an even sheet of white light is seen. Next the stage *D* is replaced with all shutters fully open, and the white light shutter is closed until the complete disappearance of the slot *I* is again secured. As mentioned above, this will occur when the shutter is open to something like 20 per cent. Finally, the sample is placed in position on the white light side, and the colour shutters are manipulated until the slot is again made to disappear.

As a typical case, a dark syrup may be matched when the colour shutters stand at red 80, green 60, and blue 10. This, then, is the record of this colour, and no other setting of the shutters will give the same colour. Should the sample be very dark, the readings of the colour scales will be rather small, and increased accuracy can be obtained by opening the white light shutter to some multiple of the standard extent, say, to 80 per cent. instead of 20 per cent. The readings on the colour side will then also read four times too great, but a simple division of the results by four will give the standard reading. Thus, the nearest readings obtainable with the standard white light illumination might be red 7, green 5, and violet 2. Upon using the higher illumination of four times intensity, the readings obtained might be red 26, green 21, and violet 8. Dividing these figures by four we obtain red 6½, green 5¼, and violet 2, as the true record of this dark material.

Apart from very greatly increased accuracy, the instrument has the advantage over other colour-testing systems that it is independent of the source of light. It is not necessary to wait for sunlit clouds in a north sky. Tests can be taken at any time of day or night with equal facility.

In addition to giving an accurate record of colour, this instrument analyses the colour, a matter of importance in many cases. For example, suppose that it is desired to decolorize a dark syrup to a definite shade of lemon yellow, the instrument shows that it is a large preponderance of red which must be removed. Experiment may indicate that one decolorizing carbon tends to remove as much green colour as red, while another will take away more red than green. The former would reduce the sample to a light pinkish brown, while the latter would bring about the effect desired. Many such lines of application have already suggested themselves to persons in various trades, and it is certain that the sugar industry will find it no less useful.

A demonstration of the effect of "Carbrox" decolorizing carbon[1] was recently given at the Capellanes sugar-house, Cuba. Five per cent. was thoroughly mixed with a syrup of 31° Bé. (about 56° Brix) during some time, the temperature being maintained at 187° F. (86° C.) during this operation. Subsequently, the syrup was passed through a small Sweetland press, when it was found to be completely decolorized. It is stated that after this nine times the amount of syrup could be passed through the press with no further addition of carbon, the first five volumes showing no change in colour, while that of the next four gradually diminished. On mixing all the filtrates, the colour was "equivalent to that obtained from bone-black filtration over a period of 18 hours." Hence the amount of carbon used for the 10 volumes was only 0·5 per cent. "Carbrox" is revivified by re-burning, and it is said to be equally efficient in alkaline and in acid solution.[2]

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[1] *I.S.J.*, 1918, 415, 577; 1919, 90, 249.

[2] *La. Planter*, 1920, 65, No. 7, 103-104.

The Question of the Distance between Cane Rows.

A Brief History of its Investigation.

By ARTHUR H. ROSENFELD.

The question of the best distance to be given between cane rows, in order to allow of the best possible development of the plants consistent with the largest possible yield per acre, is one of much importance and one which has given cause for considerable investigation and discussion. For each kind of plant and soil there should exist a theoretical maximum of the agricultural yield that can be obtained, i.e., each class of soil in each climate is capable, under the best conditions, of producing an exact maximum of well-developed sugar canes, for example, and this maximum can be obtained only under ideal climatic conditions and with perfect cultivation. This maximum also, naturally, can be obtained only by an ideal spacing of the plants, allowing each one to obtain its maximum development; hence if we have our rows too close together, we shall probably get a great number of inferior plants, and if we have them too far apart we shall probably obtain splendid specimens of sugar cane, but the reduced number of these will fail to give us the tonnage we should have obtained with more plants of normal development.

STUBBS[1] published the results of some experiments on this subject as early as 1890, using for this experiment the striped cane (Cheribon) common in Louisiana. Table I gives the results of these experiments in plant cane and in first year stubble.

TABLE I.—LOUISIANA EXPERIMENTS IN 1890 AND 1891.

Width of Middles	No. Stalks per hect.	Av. Weight of Stalks, Gms.	Met. Tons Cane per Hectare	CHEMICAL ANALYSES OF JUICES.			
				Brix.	Sucrose	Glucose	Purity
			I. Plant Cane—1890.				
3 ft.	63,998	1500	106·55	13·0	10·00	1·67	76·9
4 ft.	67,804	1400	104·13	12·5	9·30	1·69	74·4
5 ft.	64,186	1500	104·94	13·5	10·45	1·61	77·4
6 ft.	63,134	1400	95·13	13·3	10·20	1·67	76·6
7 ft.	64,641	1300	93·05	13·3	10·00	1·47	75·1
8 ft.	61,404	1400	91·75	12·8	9·60	1·48	75·0
			II. First Year Stubble—1891.				
3 ft.	86,022	1100	102·42	14·5	10·91	1·61	75·1
4 ft.	68,496	1100	82·06	14·1	10·50	1·60	74·5
5 ft.	75,414	1100	92·91	13·8	10·50	1·42	77·9
6 ft.	69,533	1200	89·08	14·0	10·30	1·73	73·4
7 ft.	68,100	1200	88·12	14·6	11·40	1·42	77·9
8 ft.	63,168	1300	86·86	14·3	10·50	1·69	73·6
			III. Average Results for the Two Years.				
3 ft.	75,010	1300	104·49	13·8	10·46	1·64	75·8
4 ft.	68,150	1250	93·10	13·3	9·90	1·65	74·4
5 ft.	69,800	1300	98·93	13·7	10·48	1·52	76·5
6 ft.	66,334	1300	92·11	13·7	10·25	1·70	74·8
7 ft.	66,371	1250	90·59	14·0	10·70	1·45	76·4
8 ft.	62,286	1350	89·31	13·6	10.05	1·59	73·9

STUBBS found, after counting the number of canes at the time of throwing the first dirt to the cane, at lay-by and at crop, that many canes die during the time of development due to lack of space for growth. This was particularly noticeable in the canes in the rows close together in the stubble year, the counts demonstrating that fifty per cent. of the canes in these rows had died before maturity. Many canes three feet in height were found dead at crop time from no other apparent cause than the lack of room for development. This observation explains how it often happens that a bad stand of plant cane may produce fairly good stubble, particularly with varieties which are strong ratooners.

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[1] STUBBS, W. C. "Sugar Cane: Results in Field and Laboratory in 1890." Bulletin 14, Second Series, Louisiana Experiment Stations, 1892.

The three and four-foot middles received no cultivation whatsoever, as no implements could be got into such narrow rows, nevertheless both as plant and as stubble the rows with only the three-foot middles have given the best tonnage of cane, the decrease in yield as between plant and stubble being markedly small. In both plant and stubble, for some peculiar reason, the cane with middles of five feet gave the second best results, in agricultural yield as well as in analysis of juices. This is probably due to the fact that the increased number of plants in rows at four feet distance does not compensate for the lack of cultivation, the five-foot middles having been thoroughly cultivated.

Although these results were not particularly surprising, they showed very clearly to the Louisiana planters, who up to that time had been using six-foot middles, that it would be in every way advisable to reduce these middles to five feet, since, outside of the question of more yield per acre, the cultivation of five-foot middles is far cheaper than that of six-foot ones, since the cane will always close more quickly over the narrower middles.

From the date of the above experiments the Audubon Sugar Experiment Station has adopted five-foot middles in all of its experiments with sugar cane.

In 1891 Stubbs repeated the same experiments, but on a much larger scale, using both the striped and purple Cheribon canes and eliminating the seven and eight foot rows as being impractical and expensive. The plantation was made in November, 1890, and the crop in December, 1891, the cultivation, fertilization, etc., having been identical in all of the plats, with the exception of those at three and four feet, where the cultivation had to be restricted. Table II gives the results of this series of experiments, and Table III the average of the three crops in the two series of experiments.

Table II.—Second Louisiana Experiment in 1891.

Variety	Width of Middles	Met. Tons Cane per Hectare	Average of Two Varieties	Chemical Analyses oe Juices.			
				Brix.	Sucrose	Glucose	Purity
Striped	3 ft.	108·5	97·7	13·48	10·10	1·31	74·83
Purple	3 ft.	86·9		13·92	10·25	1·20	73·63
Striped	4 ft.	87·2	86·8	13·57	10·30	1·53	75·90
Purple	4 ft.	86·3		12·97	9·40	1·44	72·48
Striped	5 ft.	76·8	81·3	13·45	10·22	1·35	75·98
Purple	5 ft.	85·8		13·10	9·40	1·34	71·75
Striped	6 ft.	79·8	81·0	13·12	9·42	1·45	71·80
Purple	6 ft.	82·1		13·17	9·98	1·36	75·78

Table III.—Average Results for the Three Louisiana Crops 1890-91.

Width of Middles	Met. Tons Cane per Hectare	Chemical Analyses of Juices.			
		Brix.	Sucrose	Glucose	Purity
3 ft.	102·2	13·74	10·36	1·51	75·42
4 ft.	91·0	13·39	9·88	1·59	74·37
5 ft.	93·1	13·52	10·25	1·46	75·80
6 ft.	88·4	13·49	10·07	1·60	74·60

As is well known, cane is usually planted in Louisiana every other year, i.e., it is usually carried only to first year stubble before renovation, hence it is doubtful if the increased yield at three feet would compensate in the long run for the additional amount of seed cane required to plant the cane so thick. Nevertheless the planting of the cane in five foot rows has become practically general in Louisiana as the result of these experiments, this being about the smallest distance that can be given between the rows and still permit good cultivation with machinery. There is no doubt, further, that cane planted very close is in a condition to offer more physical resistance to frost than plants which are more widely spaced.

In Bulletin No. 24 of the Louisiana Experiment Stations Dr. STUBBS gives two more interesting tables of results of similar investigations, one of the results of four years of experimentation with striped cane from one plantation and the other the average of three years' results with the striped and purple canes from the same plantation—one year of plant and two of stubble. These results will be found in Tables IV and V.

TABLE IV.—AVERAGE RESULTS IN LOUISIANA FROM FOUR CROPS OF STRIPED CANE.

Width of Middles	Met. Tons Cane per Hectare	Chemical Analyses of Juices.			
		Brix.	Sucrose	Glucose	Purity
3 ft.	78·23	14·06	10·50	1·63	74·68
4 ft.	76·01	14·00	10·47	1·71	74·64
5 ft.	83·92	13·90	10·49	1·74	75·47
6 ft.	77·94	14·28	10·97	1·76	76·82
7 ft.	77·71	14·47	11·12	1·76	76·85
8 ft.	72·50	13·92	10·47	1·79	75·22

TABLE V.—AVERAGE RESULTS IN LOUISIANA FROM THREE CROPS OF PURPLE AND

Variety	Width of Middles	Met. Tons Cane per hectare	Average of Two Varieties	Chemical Analyses of Juices.			
				Brix.	Sucrose	Glucose	Purity
Purple	3 ft.	72·33	76·87	14·47	10·93	1·45	75·53
Striped	3 ft.	81·42		14·89	11·58	1·38	77·77
Purple	4 ft.	72·77	71·50	14·32	10 97	1·46	76·60
Striped	4 ft.	70·23		14·31	10·97	1·60	76·65
Purple	5 ft.	73·04	69·81	14·20	10·92	1·42	76·90
Striped	5 ft.	66·07		14·13	10·64	1·45	75·30

Table IV shows that for four years the five foot rows again show the maximum of tonnage, while the very fine rows give the smallest yield once more, with the lowest sugar content and largest percentage of glucose of all of the plats. This latter result, which is quite general in the experiments, is diametrically opposed to the general idea, which is to the effect that the purity of wide spaced cane rows will always be superior to that of rows closer together. There is no doubt, however, that sugar cane is a *sociable* plant, and develops best under normal spacing conditions.

In Table V we see that the average yield of cane increases as the distance between the rows decreases, and once more the best sugar content and purity correspond to the rows with the narrowest middles, although the differences in the contents of the juices are very small.

Table VI gives us the average results for two years of further experiments made by STUBBS in 1892 and 1893 with both the purple and striped canes with distances between the rows of five and six feet, which were the distances most discussed in Louisiana at that time. The cultivation was, it is needless to say, identical in all of the plats, and the results embrace one crop of plant and one of stubble from the same plantation. Once more the five feet rows show up best in tonnage of cane, and in content of sugar in the juices, and the experiment serves to confirm the opinion that, while it cannot be said at just what distance the cane will give best results in tonnage and purity, there is at least no advantage in having the middles any wider than is necessary for the easy entrance of cultivation machinery. Naturally, if we plant closer together than will permit the entrance of machinery and animals, we must return to the old expensive hand and spade system of cultivation, which, with the labour question becoming every day more difficult, is unthinkable.

Table VI.—Average Results for Two Years from Experiments with Five and Six Foot Rows.

Variety	Width of Middles	Met. Tons Cane per Hectare	Average of Two Varieties	Chemical Analyses of Juices.			
				Brix.	Sucrose	Glucose	Purity
Purple	5 ft.	85 92	87·60	14·76	11·40	1·35	77·07
Striped	5 ft.	89·07		14·26	10·80	1·50	75·73
Purple	6 ft.	85·27	80·93	14·29	11·10	1·49	77·67
Striped	6 ft.	76·58		14·27	10·92	1·57	76·52

Experiments in other Countries.

In Bulletin No. 7 of the Hawaiian Sugar Planters' Experiment Station Prof. R. E. Blouin gives some details of experiments made with different widths of middles in 1901. In these experiments the Lahaina cane was used, and all plats were treated in an absolutely identical manner as regards cultivation, fertilization, irrigation, etc. Table VII gives the results of these experiments, and shows us that the five foot rows gave sixty tons more cane per hectare than the six foot ones which occupied second place. The eight foot rows once more give the smallest tonnage of cane per hectare. Blouin concludes from these experiments that the Hawaiian planters, who almost universally plant in five foot rows, have no reason whatsoever to change their system.

Table VII.—The Hawaiian Experiments.

Width of Middles	Met. Tons Cane per Hectare	Chemical Analyses of Juices.			
		Brix.	Sucrose	Glucose	Purity
4 ft.	228·08	18·88	16·80	0·53	88·98
5 ft.	302·41	17·90	15·95	0·57	89·11
6 ft.	242·72	16·96	14·63	0·80	86·28
8 ft.	220·36	16·18	14·05	0·88	86·83

Reynoso states that the ideal distance between cane rows in Cuba is five and a half feet, and Boname gives four and a half to five feet as the best for Guadeloupe.

Experiments at the Tucumán Sugar Experiment Station.

The experiments of the Tucumán Sugar Experiment Station were commenced in August, 1910, under the direction of Prof. R. E. Blouin, and continued by the author up to 1916. For data of experiments made since 1916 the author is very much indebted to Dr. W. E. Cross, the present Director of the Station.

For the first experiments a good plat of land, which seemed to have a very even composition throughout, was selected and well ploughed with a share plough and harrowed with a tooth harrow. The rows were indicated at the proper distances with the point of a share plough and deepened to ten inches with a double mouldboard plough. The ordinary purple cane (Cheribon) was planted in two continuous running rows and covered with a small share plough. The germination was perfect in all the plats, notwithstanding the great quantity of weeds due to this piece of land having been out of cultivation for some years. As plant cane the plats received four irrigations—in August, September, March and April. In November the middles were cultivated with a large four-shovel cultivator and the rows weeded with spades, the dirt being further knocked off the rows on December 1st, 1910. The middle of January the dry weeds were removed by passing a tooth cultivator down the middles, the middles broken out with two furrows of a share plough, and the first dirt thrown to the cane with small share ploughs. On the 20th the tooth cultivator was once more sent down the middles, and at the end of January all plats had the rows weeded with spades.

Early in February subplats 3, 4, 5 and 6, from the five foot rows upwards, were once more cultivated with the large four-shovel middle cultivator, the first two subplats having the rows so close together that it was impossible to enter the middles with mules or machinery. The middle cultivator was followed in subplats 3, 4, 5 and 6, from six feet apart upwards, and a small middle cultivator, drawn by one mule, was sent down the middles of the other three subplats.

From the start the cane in the wider rows appeared to be less developed than that in the narrower ones, and the crop made on 21st July, 1911, proved this to be the case, as is shown in Table VIII. At crop the canes from each subplat were carefully counted and weighed.

TABLE VIII.—RESULTS FROM THE PLANT CANE CROP OF 1911.

Subplat	Width of Middles	Average Weight Stalks, Grms.	Met. Tons Cane per Hectare	CHEMICAL ANALYSES OF JUICES				Manufacturing Value	Kgs. Sugar per Hectare
				Brix.	Sucrose	Glucose	Purity		
1	3 ft.	530	31·10	17·2	14·2	0·6	82·7	11·7	2547
2	4 ft.	670	36·52	17·2	14·7	0·5	85 5	12·6	3221
3	5 ft.	710	28·90	17·9	15·3	0·5	85·6	13·1	2651
4	6 ft.	830	38·17	17·4	14·7	0·5	84·5	12·4	3313
5	7 ft.	630	26·29	16·6	14·0	0·3	84·4	11·8	2171
6	8 ft.	580	19·54	15·8	13 0	0·6	82·4	10·7	1464

One interesting point brought out in this table is that the size of the stalks increased up to the six foot rows, from which point it once more diminished, the tonnage per hectare following a similar curve, both as regards cane and sugar. With this plant cane the six foot rows have given the best results, producing just about double the amount of cane per hectare as was produced by the eight foot rows.

The samples from each plat for chemical analysis were carefully selected according to a system worked out at the Experiment Station for securing representative samples. The analyses were made by Mr. J. A. HALL, Jr.

The factor "Manufacturing Value" is one commonly used in Tucumán, and is obtained by multiplying the percentage sucrose content by the purity. Then, assuming a 70 per cent. extraction of juice on cane, the available sugar is obtained by multiplying the tonnage of juice per hectare by this factor.

The chemical analyses of the juices are very much in accord with the agricultural yields, the eight foot rows showing up the poorest all along the line. The five foot rows show the best chemical analyses of the juice, although, due to the larger tonnage of cane, the six foot rows have produced the largest amount of sugar per hectare.

As the author has so many times remarked, however, conclusions must never be formed from one year's experiments with sugar cane, as climatic conditions for one year or the difference in the growing characteristics of plant and stubble cane may cause us to radically change our opinions in later ones. Let us study, then, the behaviour of these plats as first year stubble.

The middle of September two furrows were run down each middle with a share plough and the cane was then off-barred with the same implement, with the addition of a knife coulter. At the end of the same month a good irrigation was given, and on Nov. 10th, 1911, a little dirt was thrown to the cane with a small share plough. At the end of November, subplats 3 to 6, i.e., the middles from five feet on were cultivated with the large four-shovel middle cultivator and dirt thrown to the cane with the six-disc riding cultivator. In the first two subplats a small five-tooth cultivator drawn by one mule was sent twice down the middles. Early in January subplats 5 to 6, or the middles from six to eight feet, were given two passings of the large four-shovel cultivator and the other three subplats received two passings of the small cultivator. At the end of the same month the small middle cultivator was sent down the middles of all the subplats, thus completing the cultivation. Crop was made the middle of June, 1912, with the results shown in Table IX.

TABLE IX.—DEFINITE RESULTS FROM THE FIRST TUCUMAN EXPERIMENTS.

Subplat	Width of Middles	Average Weight of Stalks, Grms.	Met. Tons Cane per Hectare	Chemical Analyses of Juices				Manufacturing Value	Kgs. Sugar per Hectare
				Brix.	Sucrose	Glucose	Purity		
		I. Crop of First Year Stubble—1912.							
1	3 ft.	840	35·14	15·8	13·0	0·5	82·3	10·7	2632
2	4 ft.	780	34·32	15·8	13·2	0·5	83·5	11·0	2643
3	5 ft.	770	33·01	15·4	12·3	0·5	79·9	9·8	2264
4	6 ft.	740	30·36	15·1	12·3	0·6	81·5	10·0	2125
5	7 ft.	720	29·15	15·9	13·2	0·5	83·0	11·0	2245
6	8 ft.	810	28·41	16·6	14·2	0·5	85·4	12·1	2406
		II. Average Results for the Two Years.							
1	3 ft.	690	33·12	16·5	13·6	0·6	82·4	11·2	2597
2	4 ft.	730	35·42	16·5	14·0	0·5	84·8	11·9	2942
3	5 ft.	740	30·96	16·7	13·8	0·5	82·6	11·4	2471
4	6 ft.	790	34·26	16·7	13·5	0·5	82·8	11·2	2686
5	7 ft.	680	27·72	16·3	13·6	0·3	83·4	11·3	2193
6	8 ft.	700	23·98	16·2	13·6	0·6	83·9	11·4	1914

It will be seen from this table that the yield of stubble cane increased in inverse proportion to the distance between the rows and that the chemical analyses of the juices do not seem to bear any definite relation between each other. The average yields for the two years give the place of honour in production of sugar per hectare to the four-foot rows, followed by the six-foot ones. BLOUIN[1] concluded from these experiments that, for questions of cultivation, the distance between the rows should not be less than five feet, and, for questions of yield, more than six feet, recommending an average of five and a half feet.

To show the small difference in yield and sugar content between the distinct plats, which averaged five and a half foot middles, BLOUIN made the following table by combining the yields from the three and eight foot rows, the four and seven foot, and the five and six foot rows, each pair averaging just five and a half feet.

TABLE X.—AVERAGE YIELDS AT FIVE AND A HALF FEET.

Subplats	Distances	Met. Tons Cane per Hectare	Average per cent. Sucrose in Juice
1–6	5 and 8 ft.	28·55	13·6
2–5	4 and 7 ft.	31·57	13·8
3–4	5 and 6 ft.	32·56	13·7

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[1] *Revista Industrial y Agricola de Tucumán*, Ano III, pp. 474-77, 1913.

The plat in which the above experiment was made was left fallow until August, 1915, when it was carefully ploughed and harrowed and planted with the P.O.J. 36 cane. The same distances between the rows were employed in the subplats, the plats however being reversed, so that the narrow middles occupied the place of the former wide ones and *vice versa*. At the end of that month a good irrigation was given all subplats and early in October dirt was knocked off the rows with spades, all subplats being cultivated the middle of November with a small Planet Jr. cultivator. At the end of November all rows were weeded with spades and on December 9th another cultivation was given the middles with the Planet Jr. cultivator. The rows were once more weeded at the end of December, 1915, and the Planet Jr. cultivator sent down all middles at the beginning and end of January, 1916, the latter operation being followed with the six-disc lay-by machine in the rows which could be entered.

It should be stated here that, as in previous experiments, the three-foot rows had to be cultivated only with the spade, as no animals could enter such narrow rows. It is also to be noted that the cane planted with middles from six feet up had to have the cultivator passed twice, whereas with the cane at four and five feet one passing was sufficient.

At the beginning and end of February the Planet Jr. cultivator was sent down the middles, finishing the cultivation of the plant cane, which was harvested at the end of June, 1916.

The trash was burnt in August, 1916, and at the end of that month the middles were broken out and the rows off-barred as previously described. Early in September all of the subplats except No. 1 (three-foot rows) had the stubble shaved and dug with the machines for that purpose, this work being imitated as well as possible in the three-foot rows with machetes and spades. This was followed by a good irrigation, and the middle of September the Planet Jr. cultivator was sent down the middles. Early in October a little dirt was thrown to the cane with a small share plough, and at the end of the month the middles were cultivated once more with the Planet Jr. machine and all the subplats irrigated, the cultivation being given after the irrigation water had lowered a bit. At the end of December the subplats were again cultivated and then laid by with the six-disc straddling cultivator. Four irrigations were later given—one the middle of January and one the end of the same month, both of these being followed by cultivation of the middles, another the middle of March, and the last the first of May. The first year stubble was cropped on 9th August, 1917.

As second year stubble the cane was burnt off and the subplats all irrigated before having the middles broken out and the rows off-barred on September 10, 1917. The stubble was then shaved and dug as already described for the previous year and another irrigation given the end of September. On October 10th and 25th cultivations were given the middles, and the middle of November a little dirt was thrown to the rows with the six-disc straddling cultivator, this operation being followed by another middle cultivation. Three more irrigations were given, one each in November, December and January, in each case being followed by light middle cultivations in order to preserve a dust mulch. The harvest of the second year stubble was made July 20th, 1918.

As third year stubble the trash was burnt as before and the subplats irrigated early in September, 1919, this being followed by the cutting and digging of the stubble of all of the subplats except those with three foot middles after the proper middle-breaking and off-barring on September 9th. Later the middles were harrowed down and cultivations were given with the light Planet cultivator on 15th October, 9th and 30th November, 20th and 29th December, and 21st January. A little dirt was thrown to the rows the middle of November and the final lay-by given on 21st December, the large six-disc straddling cultivator being used for this work in both cases. The third year stubble was dropped on August 9th, 1919.

To save space in an already rather lengthy article, we give below only the average results from the four crops, i.e., one of plant and three of stubble from the same plantation. It will be noticed from Table XI that the average quantity of cane produced per hectare varied very little between the three and seven foot subplats. The yield showing an appreciable diminution, however, in the rows planted at eight feet.

TABLE XI.—AVERAGE YIELDS IN P.O.J. 36 EXPERIMENT FOR FOUR YEARS.

Width of Middles	Average Weight Stalks, Grms.	Met. Tons Cane per Hectare	Kgs Sugar per Hectare
3 ft.	654	67·89	5470
4 ft.	714	71·00	5954
5 ft.	776	68·13	5569
6 ft.	809	68·28	5733
7 ft.	832	69·43	5747
8 ft.	804	62·46	5536

The average size of the stalks has followed a quite natural course of increasing with the distance between the rows, this increase being remarkably steady up to the seven foot rows.

Summarizing the results of this experiment, CROSS[1] comes to the following conclusions:—

These results with the P.O.J. 36 cane confirm those already obtained in the Experiment Station with the Creole cane, indicating that approximately the same quantities of cane and sugar per hectare are obtained with rows planted at any distance between three and seven feet. The decision as to the distance to be given between the rows, therefore, should depend upon the economic factor, i.e., such a width of middles should be employed as results most economical from every point of view. Too little distance is not advisable on account of not permitting cultivation, lay-by, etc., with modern machinery (cultivators, lay-by machine, etc.). On the other hand, rows which are too far apart will signify a late closing up of the cane and an excessive number of cultivations. The distance to be selected, therefore, should be *the smallest which will permit efficient cultivation of the cane plant as well as stubble, with modern cultivation machinery.* With the tremendous suckering tendency of the Java canes, this distance will have to be greater than that commonly given for best results with the old Creole ones, but we think, nevertheless, that a width of middle of from five and a half to six feet should be sufficient to permit proper cultivation of the cane with the distinct types of cultivating machinery in use in the province.

(*To be continued.*)

Recently, the Natalite Motor Spirit Co., of South Africa, held a meeting to discuss the disposal of the unsold patent rights to the Alcohol Fuel Corporation, of London in exchange for a half-share (100,000 of the 200,000 issued) of the Corporation. Later, however, the Company received an interdict annulling the resolution passed, thus preventing them from disposing of its property unless voted by a majority of more than 75 per cent. of the shareholders representing more than 75 per cent. of the issued capital.

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[1] *Revista Industrial y Agricola de Tucumán*, vol. x, pp. 87-100, 1919.

Production of "Karbos" Decolorizing Carbon.[1]

By C. F. BARDORF.

The chemistry of decolorizing carbon has been describing a decidedly upward curve during the last 10 or 15 years. It is with this consideration that the author ventures to outline a series of experiments begun in 1911, which, however, were unwillingly laid by in 1913. In 1916 he read a paper on Tintometry before this section,[2] and indeed the facts presented therein were the results of an endeavour to establish a fairly reliable and comparative colour analysis as a preliminary step towards a systematic investigation of some char problems.

The first preliminary experiments were made in the laboratory of the St. Laurence Sugar Refineries, Ltd., with "Eponit" along the lines indicated by the late Dr. STROHMER.[3] On revivifying experimental lots of this carbon in a small cylindrical iron retort by heating to a dull red heat, 800° F. (426° C.,) it was found to have a higher decolorizing power than the crude material, which later was traced to the presence of salt having an alkaline reaction. It is an old-established fact that sugar solutions can best be decolorized after the liquid has been brought to a neutral or acid reaction. Furthermore, the presence of phosphates, as will be shown later, enhances the decolorizing power of most blacks. Therefore, the raw "Eponit," or rather the alkalinity of its salts, was neutralized by phosphoric acid.

Composition of "Eponit."—Concurrent with the laboratory work, practical tests were made, and the general conclusion was that "Eponit" might be with advantage modified in its physical structure without prejudice to its chemical efficiency. Inferentially, "Eponit" is a by-product from the manufacture of a paraffin-like wax, ceresin, which is understood to be extracted from peat. "Eponit," undoubtedly, is a soot, but when compared with ordinary dull lampblacks of the market, it has a distinctly lustrous appearance. A microscopic examination was made, and the result was surprising. Instead of a dull, lustreless agglomeration of soot particles under an amplification of 200 diam, the black was seen to be composed of innumerable, fine, needle-shaped plant tissues, richly covered with nodules of microscopic carbon masses. Of course, the tissues were charred, but were quite distinctly constituents of the black. Clearly, then, the characteristics were most striking and the word "amorphous" could hardly be applied with justice to a substance in which the structure of the plant tissue could be so readily seen. Without doubt, "Eponit" was proved to be no homogenous substance, as would be inferred from Dr. Strohmer's description.[4] The characteristic dispersion of the carbon particles upon the tissues was kept in mind, and later led to the idea of the advantage of adding an inert substance not only to "Eponit," but to any sooty black, for the double purpose of facilitating the manipulation and improving still further the decolorizing effect.

Having come to the conclusion that "Eponit" is nothing more than an exceptionally fine soot, the next question was its unique distinctive character. Evidently an attempt at the manufacture of "Eponit" was next made by rasping a brick of dried peat to a coarse powder, which was heaped upon a finely-meshed iron screen, above which several lengths of ordinary stove-pipe was fixed. Above the stove-pipe an ample bell-jar, with tubular opening at the top, was placed. The pile of rasped peat was ignited and kept burning at the edges so that the smoke passed up through the pipe, and soot was deposited inside the comparatively cool bell-jar. At the conclusion of the experiment, about a teaspoonful of soot was secured from the jar. Portions of it were submitted to all the decolorizing, physical, and chemical tests that had been applied to "Eponit." The laboratory product responded affirmatively to every test, and therefore proclaimed itself true "Eponit," which evidently is a soot product, and though it be regarded as such, the mode of its production suggested a new line of investigation in the manufacture of decolorizing blacks. For instance, by the destructive distillation of coconut shells a very powerful decolorizing black was produced.

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[1] Resumé of a paper read before the Montreal branch of the Society of Chemical Industry; published in the *Canadian Chemical Journal*, 1920, 4, 207.

[2] *I.S.J.*, 1917, 306-312. [3] *I.S.J.*, 1911, 34 and 496. [4] *Loc. cit.*

In passing, it may be stated that of all the blacks examined—and not excluding ordinary lamp-black—"Eponit" was found to have the lowest apparent specific gravity. Apparently here is a promising field and a likely line of departure from the conventional production of these and similar blacks. The usual line followed in black production is to seek dispersion of the carbon particles by mixing the carbon-yielding material with lime, kaolin, diatomaceous earth and the like. But if the burning of plant tissues be the base of carbon production, the cost of these dispersion inducers may be avoided and the partial destruction only of the tissues may, indeed, prove efficacious.

Having learned the structural nature of "Eponit," it was decided to modify the black, and also to experiment with the view to producing a black of similar nature for further information. A great many substances were experimented with, among them saw-dust, blood, peas, peat, bone-oil and paraffin. These, and mixtures of them, were decomposed by heat under varying conditions, and in some cases the mixtures were treated with hydrochloric acid, phosphoric acid, or sodium hydroxide. Again, heating under pressure—up to 200 lbs.—was essayed, but no encouraging results obtained.

In the face of these failures, there still remained an old standby—namely, the purified animal black of years ago. But the one great objection to the use of dusty or sooty blacks is that they all tend to very soon clog the filter-presses used for filtering out the black after it has done its work as a decolorant. However, the significance of the acidular plant tissues found in the "Eponit" was here applied and some charred sawdust was mixed with prepared carbon from decomposed char-dust, or even ground discarded char from the refinery. The result was highly satisfactory; a decolorizing black was now at hand fully as efficient as "Eponit," and having none of its objectionable features.

"*Karbos," a new production.*—Raw and charred sawdust have long been known as excellent press-filtering media, and as fully 50 per cent of charred sawdust could with advantage be mixed with animal carbon another purpose was also served—namely, the immobility of the new black was much less marked; indeed, so much so that there was every promise that heat regeneration would be possible in a somewhat modified char-kiln. This new black, therefore, had specific features, and was placed among its competitors under the name of "Karbos." Furthermore, it proved such an excellent filtering medium that upon one occasion an experimental run through a filtering press not only filled the press with the carbon, but also a foot of the feed-pipe, and still the press kept running freely.

"Karbos" is prepared by digesting 1 kg. of 100 mesh char-dust with 1250 c.c. of 18° Beaumé commercial hydrochloric acid for 20 hours. The resulting pasty mass is then worked up with 23 litres of water, 70 grms. charred sawdust added, and the whole agitated by an air current, or by mechanical means, and filtered as rapidly as possible. The resulting black is washed with two batches of water of 23 litres each, the first batch being retained to dilute a subsequent lot of paste, while the second is run to waste, as it contains practically no phosphates.

The large quantity of water is necessary, as otherwise "reverted" phosphate deposits upon the black, reducing its efficiency. The phosphate liquor filtered from the "Karbos" has a density of from 7° to 8° Beaumé, equal to 13 to 14 per cent. of superphosphate, and may serve as a defecating agent or may be concentrated and sold as superphosphate of lime.

Success with "Karbos" again brought the interest of modifying "Eponit" to the front yet further, so 30 to 50 per cent. of charred sawdust was mixed with some of this material, thus increasing the plant tissue in the black and offering a larger surface to which the elementary carbon would adhere. It was expected that by securing a greater dispersion of the amorphous carbon particles their aggregate efficiency would be increased. Decolorizing experiments made with such modified "Eponit" demonstrated that the "Eponit" in the mixture had increased in its efficiency by something like 25 per cent.

Chemistry in decolorizing blacks.—The presence of the elements, H, N, and O in char has been recognised since 1850, or thereabouts, but for a time it was inferred that these elements, as such, were held as occluded gases. T. L. PATTERSON,[1] however, was the first, as far as the writer knows, to demonstrate that the "carbon" usually reported in char analysis is really composed of carbon and a carbonaceous complex containing, besides carbon, also H, N, and O. Indeed, he stated that "the combination in which N exists in animal charcoal has not hitherto been investigated."

The so-called "carbon" in animal charcoal is usually determined by dissolving the calcium phosphate and other salts of the char in hot hydrochloric acid, washing out with water, drying and weighing the residue. The residue is incinerated and the combustible part is reported as carbon. The reported carbon is not the element carbon only, but a mixture of carbon and a nitrogenous body of the empirical formula $C_{25}H_{20}N_4O_6$. Ultimate analysis shows it, in round percentages, to contain: C, 63; H, 4; N, 12; and O, 21 per cent. PATTERSON extracted this substance—let us call it "nitro-body" for convenience—from the hydrochloric acid insoluble residue by digesting it in cold sulphuric acid. Upon diluting the sulphuric acid with water, the nitro-body is obtained as a dark brown, flocculent, gelatinous precipitate. A second extraction with hot sulphuric acid takes out a further quantity of the same body, or a very similar one.

PATTERSON's char investigations, as set forth in the paper, are devoted to the discussion of many interesting view-points in char chemistry, but confining ourselves to the nitro-body, there is this important practical feature about it—that it possesses a very high decolorizing power when it is allowed to react on caramel and sugar solutions without destroying its gelatinous condition. According to PATTERSON, this nitro-body in its original suspension will decolorize 17·43 c.c. caramel solution, which makes it 16 times better a decolorizer than good charcoal. But if the nitro-body be dried and then ground and applied in this state as a decolorant, its power falls to 10·0 per cent. below that of standard charcoal. The practical importance of PATTERSON's work lies in showing that this nitro-body gradually disappears under reheating of the char. Virgin char may contain as much as 2 per cent. of the body (the author has found as much as 2·8 per cent.), but a char that has been in use eight weeks contained only 0·3 per cent., while in a discard char the percentage had fallen to 0·04 per cent.

There are a great many other interesting features connected with this nitro-body, and some of them are discussed by PATTERSON. It is a matter of regret, however, that no study was made relative to the comparative decolorizing power of the nitro-body and the denitrogenized carbon from which the nitro-body has been extracted. Such an investigation would have been of immense value from a theoretical as well as a practical point of view. Probably a few experiments in this direction might have answered the significant question whether the elementary carbon or the nitro-body has the greater decolorizing power.

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[1] *Jl. Soc. Chem. Ind.*, 1903, 608-614.

Not more than two classes of decolorizing blacks are at the disposal of industries to-day. In the first, animal black stands as the only representative and is without a rival. In the second may be placed all those dusty, sooty, highly comminuted blacks, among which "Eponit" may be regarded as typical. As has already been remarked, the general effort toward the commercial production of this class of blacks is to mix vegetable organized material with some such substance as lime, clay, etc., which all, in a manner, act as dispersive agents for the carbon particles. The action of these dispersive agents may be regarded as analogous to the function of bone tissue in animal black.

We have at hand to-day a superabundance of decolorant blacks (as "carboraffin," "molasschar," etc.),[1] most of which, under proper manipulation, may serve some practical purpose, more particularly, perhaps, where comparatively small volumes of coloured solution require decolorization, aqueous extracts, for example; but the next urgent need is a thorough study of their physical and chemical properties. They must all be tested by some standard method. The generally loose statements as to their specific power are either valueless, or, what is worse, misleading. A black may do wonderful work, but can it be readily revived, and how often, is quite as important.

In the author's opinion, the next line of progress should be to find a specific or general dispersive medium which will enable each particle of the decolorization carbon to exercise its full function. If, let us say, charred sawdust should prove to be such a dispersive medium for the minute carbon particles of active black—that is, the only part of the black exercising a decolorizing power—it seems probable that the study of decolorizing phenomena of these products will be made more definite. This belief is strengthened by the fact that similarly conducted tests did not always give quite concordant results at first, and the trouble was traced to the method of adding the decolorant to the solution under examination. This refers more particularly to blacks of the "Eponit" type. When no dispersive material is added to such blacks there is a tendency of agglomeration and the full power of the active black cannot be exerted, or, again, agglomeration may be more pronounced in one experiment than in another. Again, in a black like "Karbos," it was observed that the extent of the comminution of the char-dust had a marked influence on the final decolorizing power of the finished black. Thus powdered char passed through 60, 80, 100, or 200 mesh sieves proved successively more powerful a decolorant as the comminution was increased.[2]

In closing, it may be remarked that comparative claims of the power of a black are almost invariably cast upon an entirely erroneous basis. The practice seems to be to compare a black weight for weight, while comparison should be based upon the active decolorizing base in the particular product under examination. As an illustration, when char is taken as the unit of comparison, it is frequently stated that such and such a black has 5, 6, 10, yes, 20 times the decolorizing power of char, forgetting that the black of high power simply owes that quality to the fact that it may contain five or six times more active black than the char with which it is compared.

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[1] See also *I.S.J.*, 1919, 168; 1919, 625.

[2] See also Bradley, *I.S.J.*, 1920, 52.

The Double Polarization Method for the Determination of Sucrose.[1]

By RICHARD F. JACKSON and CLARA L. GILLIS.

(*Continued from page 514.*)

INFLUENCE OF IMPURITIES ON THE DOUBLE POLARIZATION METHOD.

These impurities may be invert sugar, non-sugars, and raffinose. It is necessary to study the behaviour of these constituents during the analysis, the requirement for an exact result being that all optically-active substances except sucrose shall remain unchanged in the presence of hydrochloric acid.

Effect of reagents on invert sugar.—Varying amounts of hydrochloric acid were added to solutions of pure invert sugar, obtained by inverting refined sugar with the enzyme invertase. The results obtained showed that within wide limits the relationship is linear, even when the amount of acid varies between 0 and 40 c.c. of 6·4 N per 100 c.c., which is contrary to the findings of TOLMAN.[2]

The effect of hydrochloric acid on the rotation of invert sugar may be stated in terms of the negative constituent of the divisor by the equation: $R = -42{\cdot}00 - 0{\cdot}125\,C$, in which C represents the c.c. of 6·34 N acid in 100 c.c.; or $R = -42{\cdot}00 - 0{\cdot}5407\,m = -42{\cdot}00 - 1{\cdot}972\,N$, in which m represents the grms. of anhydrous HCl in 100 c.c., and N the normality of the solution with respect to the acid.

In other words, the rotation of invert sugar is in aqueous solution — 42·00 and in acid solution — 43·25. Here at once we have a very serious source of error, inasmuch as in the analysis the change of rotation of the invert sugar (or reducing sugars) already present in the sample would be reported as sucrose.

Realizing that it would be desirable to find some reagent to add to the direct polarization which would have the same effect on the invert sugar as the hydrochloric acid, an examination was made of the effect in this respect of a number of acids and neutral salts. Acetic acid (in greater excess than that generally used to decompose the lead-levulosate compound) was found to cause a diminution of the negative rotation of invert sugar. Hence the use of this reagent would only aggravate the effect which it was intended to correct. Phosphoric acid was observed to increase the negative rotation, but also to cause a very considerable inversion of sucrose while reading the polarization.

However, it was discovered that there is a large class of neutral salts which influence the rotation of invert sugar in the same direction as hydrochloric acid, among which are sodium chloride, ammonium chloride, calcium chloride, and potassium oxalate. If, then, the mixture to be analysed consists of invert sugar and sucrose, it is merely necessary to add to the direct polarization solution a quantity of the salt sufficient to raise the rotation of the invert sugar to the same value which it would have in the presence of hydrochloric acid in the invert polarization.

In the case of sodium chloride, the rotation in terms of the negative constituent of the divisor is expressed by the equation: $R = -42{\cdot}00 - 0{\cdot}540\,m$; and in that of ammonium chloride by $R = -42{\cdot}00 - 0{\cdot}563\ m$, in which m is the number of grms. of the salt in 100 c.c. of the solution. Comparing the formula in the case of sodium chloride with that expressing the effect of hydrochloric acid, it is found that 1 grm. of NaCl produces almost identically the same effect as 1 grm. of HCl. Contrary, therefore, to the general impression, it is not because of its acidity that hydrochloric acid exerts its influence. This effect is but a single instance of the general truth that all dissolved substances affect to a greater or less degree the rotation of all optically-active substances. As far as can be stated now, the effect of inorganic substances on the rotation of invert sugar is a complicated function of both ions, and can in no instance be ascribed directly to mere acidity or neutrality. Inasmuch as equal weights of salt and hydrochloric acid exert the same influence on invert sugar, it is obvious that upon neutralization after inversion the weight of salt will be about 1·6 as great as the weight of the acid. It was possible to show that the rotation of the neutralized invert sugar solution does show an elevation about 1·6 times as great as that of the acid solution. The weight of NaCl causing the same change rotation as 5 c.c. of 38·8 per cent. HCl is 2·315 grms., and of NH_4Cl, 3·392 grm.

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[1] Editorial Summary of *Scientific Paper, No. 375, Bureau of Standards, Washington, D.C., U.S.A*, (This Bulletin is obtainable of the Superintendent of Documents, Government Printing Office. Washington, D.C., U.S.A.; price 10 cents.)—An abstract of this important research has already been given, for which see *I.S.J.*, 1920, 175.

[2] Bulletin No. 73; Bureau of Standards.

Effect of reagents on sucrose.—The effects of these neutral salts upon the rotation of sucrose were carefully measured, and it was evident that the rotation is diminished in a linear relation with the quantity of salt added. Furthermore, it was clear that if the concentration of the salt is measured with care, the rotation of sucrose in the presence of salt is capable of the same accuracy of measurement as the rotation of pure sucrose solutions. We can therefore use for a given salt concentration the corresponding rotation of sucrose with the same confidence that we use that of the normal weight of sucrose in pure aqueous solution.

The rotations of normal sucrose solutions in the presence of neutral salts are expressed by the following formulas :—

$$R_{\mathrm{NaCl}} = 100 - 0{\cdot}265\ m \qquad R_{\mathrm{CaCl_2}} = 100 - 0{\cdot}339\ m$$

$$R_{\mathrm{K_2C_2O_4}} = 100 - 0{\cdot}234\ m \qquad R_{\mathrm{NH_4Cl}} = 100 - 0{\cdot}169\ m$$

m representing the grms. of salt present in 100 c.c. of the solution.

VALUE OF THE CLERGET DIVISOR IN THE PRESENCE OF ACIDS AND SALTS.

Inversion by acid of varying concentration.—Pure sucrose was inverted by acid of varying concentration, each experiment furnishing an absolute and independent value. The conditions previously stated were used,[1] and the rotations found were expressed by the following equations—

$$R = -42{\cdot}00 - 0{\cdot}125\ C = -42{\cdot}00 - 0{\cdot}5407\ m = -42{\cdot}00 - 1{\cdot}972\ N,$$

in which C is the c.c. of 6·34 N hydrochloric acid, m the grms. of anhydrous HCl, and N the normality with respect to acid in 100 c.c. of the solution polarized.

Discussion of results.—In the experiments made by adding acid to solutions already inverted by invertase, the value —43·25 was used as the point of reference on which all the other determinations were based. None of these solutions was heated in the presence of acid, nor did any remain exposed to the action of acid longer than the necessary time of observation. Hence the question of the decomposition of the invert sugar was entirely eliminated. On extrapolating the curve on which this series was plotted to zero concentration of acid, the value —42·00 was obtained as the rotation of invert sugar in aqueous solution when 13 grms. of sucrose is inverted, and the polarization multiplied by 2.

This second series of values was obtained by starting with sucrose and inverting with acid of varying strength, and on plotting in the same way and extrapolating to zero concentration of acid, identically the same value for the rotation in pure aqueous solution was found. Now, this coincidence of the two curves, in one of which we know no decomposition of invert sugar had occurred, necessitates that in the other also no decomposition is involved. We may now conclude that under the conditions of the inversion specified no measurable decomposition occurs.

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[1] *I.S.J.*, 1920, 512-513.

Another interesting conclusion relates to the value —42·00 for the rotation of pure invert sugar in aqueous solution. Fortunately we have available the result obtained by the use of invertase by C. A. BROWNE[1], namely —42 on the Herzfeld-Schönrock standardization of the sugar scale, or —42·03 converted to the Bates and Jackson scale. This therefore is within the 0·03° of the polarization which we obtained by starting at —43·25 and determining the slope of the curve by two different methods. On the other hand, if we start with Herzfeld's result —42·66, and extrapolate by means of the slope of our acid-concentration curves, we arrive at the value —41·4, which is hopelessly at variance with Brown's value, —42·00. STEUERWALD[2] found a value of —45·54 on the Herzfeld-Schönrock scale, or —45·58 calculated to the Bates-Jackson, and if we interpolate between this value and the invertase value of —42·03 in the presence of 28·59 c.c. of 6·34 *N* hydrochloric acid, we obtain for 10 c.c. of 6·34 *N* acid the rotation —43·27, which differs from ours only by 0·02 S. We may therefore conclude that the accessory data furnish a strong corroboration of —43·25° *S* for the rotation of invert sugar in the presence of 0·634 *N* hydrochloric acid. Herzfeld's value can in no way be reconciled with these experiments.

VALUE OF THE DIVISOR IN PRESENCE OF NEUTRALIZED ACID.

Neutralizing with sodium and ammonium hydroxide.—After the completion of the inversion, the solution is cooled, and the equivalent quantity of alkali added from a burette; but it was found necessary to make this addition slowly and with continual shaking in order that the invert sugar should at no time be exposed to the strong alkali. A very slight alkalinity is sufficient to cause a rapid destruction of the invert sugar, and it is safer to leave the solution very slightly acid. A solution of invert sugar which would polarize —43·25 in acid solution would polarize —44·00 if the acid is neutralized by sodium hydroxide, the relationship being expressed by the equation, $R = -42{\cdot}00 - 0{\cdot}540\, m$, in which m is the grms. of salt in 100 c.c. of solution.

In the case of a solution of invert sugar containing an excess of sodium hydroxide, it was found the next morning that it retained but two-thirds its original rotation; whereas in the case of a solution in which an equivalent excess of ammonia was present, the rotation remained quite unaffected during the same time. It was therefore decided to substitute ammonia for sodium hydroxide as the neutralizing agent in the proposed method of analysis.

On determining the value of the Clerget divisor in the presence of 0·634 *N* ammonium chloride (3·392 grms. per 100 c.c.) by inverting with 10 c.c. of 6·34 *N* acid as usual and neutralizing with ammonia, the value of — 33·91 as the divisor for twice the rotation of 13 grms. at 20° C. was found.

ANALYTICAL PROCEDURE.

Error due to change of concentration.—The specific rotation of invert sugar changes considerably with a change in concentration. In Herzfeld's modification the normal weight is contained in 100 c.c. of solution for the direct reading, and the half normal in the same volume for the invert polarization. If pure invert sugar is subjected to the double polarization analysis, we would actually find — 0·7 per cent. of sucrose, all other sources of error being eliminated. In such a case (an extreme one), it is very necessary that the concentration of invert sugar should be the same in both polarizations.

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[1] *I.S.J.*, 1917, 139-141. [2] *I.S.J.*, 1913, 489.

Quite another question arises if the invert sugar is one constituent of a sucrose-invert sugar mixture. In such a case, the invert sugar is at a relatively low concentration in the direct polarization, and at a relatively high one in the invert polarization, when all the sucrose has become invert. The problem, then, is to determine whether the original relatively small quantity of invert sugar produces the same rotation in the presence of sucrose that it does if all the sucrose is inverted. An experiment made with the purpose of examining this point showed that the invert sugar produces about the same rotation in the presence of sucrose as it does if the sucrose is inverted, and quite a different rotation if diluted with water. But this experiment was inadequate in scope, and the question of this concentration effect must be considered an outstanding source of uncertainty. For the present, we suggest that if the sample to be analysed contains invert sugar, both polarizations be made at the same concentration of total substance. This involves but a slight complication in procedure.

Evaluation of the divisor.—The divisor is composed of a positive constituent (the rotation of sucrose), and a negative one (the rotation of the inverted sucrose), each rotation being measured under such conditions that other optically-active substances have the same value in both polarizations.

In aqueous solution, 100° is the value of the positive constituent at 20° C. We have previously shown that if reducing sugars of approximately the composition of invert sugar are present, in order that their rotation shall be constant it is necessary to add a neutral salt to the solution for direct polarization. When 5 c.c. of 38·8 per cent. hydrochloric acid is used to invert, the quantity of sodium chloride required is 2·315 grms. in 100 c.c., and this diminishes the rotation of sucrose to 99·38°. The corresponding values for ammonium chloride are 3·392 grms. and 99·43° and the positive constituents are: (*a*) $R = 100 - 0{\cdot}27\,m$ in the case of sodium chloride; and (*b*) $R = 100 - 0{\cdot}169\,m$ in that of ammonium chloride, in which m is the weight of the salt contained in 100 c.c. of the invert polarization.

Regarding the negative constituent, if 5 c.c. of 38·8 per cent. hydrochloric acid, or 10 c.c. of 6·34 N, are used to invert, the negative constituent is — 33·25. When C c.c. of 6·34 N acid are used it is $- 32{\cdot}00 - 0{\cdot}125\,C$. If the 10 c.c. of 6·34 N acid is neutralized by ammonia, it becomes — 33·91. When C c.c. of 6·34 N acid are used, it is $- 32{\cdot}00 - 0{\cdot}191\,C = - 32{\cdot}00 - 0{\cdot}563\,m$, in which m represents the grms. of ammonium chloride in 100 c.c. of inverted solution.

For ready reference the equations from which the value of the divisor may be computed are assembled below :—

Positive.	*Negative.*
$R = 100{\cdot}00.$	$R = - 32{\cdot}00$
$R_{\mathrm{NaCl}} = 100 - 0{\cdot}265\,m.$	$R_{\mathrm{HCl}} = - 32{\cdot}00 - 0{\cdot}5407\,m.$
$R_{\mathrm{K_2C_2O_4}} = 100 - 0{\cdot}234\,m.$	$R_{\mathrm{NaCl}} = - 32{\cdot}00 - 0{\cdot}540\,m.$
$R_{\mathrm{CaCl_2}} = 100 - 0{\cdot}339\,m.$	$R_{\mathrm{NH_4Cl}} = - 32{\cdot}00 - 0{\cdot}563\,m.$
$R_{\mathrm{NH_4Cl}} = 100 - 0{\cdot}169\,m.$	

m as before being the amount of reagent present in 100 c.c. of the solution. The algebraic difference giving the basic value of the divisor must be corrected for concentration and temperature by the equation :—

$$+ 0{\cdot}0676\,(m - 13) - \frac{t}{2}$$

in which m is here the grms. of sucrose taken for the invert polarization and t the temperature (in degrees Centigrade).

Raffinose formula.—In Creydt's derivation of the raffinose formula,[1] the direct polarization is $P = S + 1{\cdot}852\ R$, and the invert reading of a solution containing 13 grms. of inverted sucrose in the presence of $0{\cdot}634\ N$ hydrochloric acid multiplied by 2 is: $P' = -\ 0{\cdot}3325\ S + 0{\cdot}9490\ R$, in which P, S, and R are respectively the direct reading, the sucrose per cent., and the raffinose per cent., whence eliminating R from these two equations we obtain $S = 0{\cdot}5124\ P - P/0{\cdot}8449$, and $R = P - S/1{\cdot}852$.

If the inverted solution is neutralized exactly by ammonium hydroxide, we have: $P'' = -\ 0{\cdot}3391\ S + 0{\cdot}9490\ R$; whence $S = 0{\cdot}5124\ P - P''\ 0{\cdot}8515$. These equations are strictly applicable only when the analysis is conducted at 20° C., and the invert solution contains 13 grms. of inverted sugar. When applying the ordinary procedure, the following equation is applicable for various temperatures and concentrations:—

$$S = \frac{P\,(0{\cdot}4724 + 0{\cdot}002t) - P'}{0{\cdot}8961 + 0{\cdot}000676m - 0{\cdot}003t} \qquad R = \frac{P - S}{1{\cdot}852}$$

But when the inverted solution is neutralized by ammonium hydroxide, it becomes:

$$S = \frac{P\,(0{\cdot}4724 + 0{\cdot}002t) - P''}{0{\cdot}9027 + 0{\cdot}000676m - 0{\cdot}003t}$$

in which m represents the grms. of sucrose taken for the invert solution. The temperature corrections take into consideration only the invert polarization. If the temperature coefficient of the rotation of sucrose is included, the two equations are:

$$S = \frac{[1 + 0{\cdot}0003\,(t - 20)]\ \ [P' - P\,(0{\cdot}4724 + 0{\cdot}002t)]}{0{\cdot}8961 + 0{\cdot}000676m - 0{\cdot}003t}$$

$$S = \frac{[1 + 0{\cdot}0003\,(t - 20)]\ \ [P'' - P\,(0{\cdot}4724 + 0{\cdot}002t)]}{0{\cdot}9027 + 0{\cdot}000676m - 0{\cdot}003t}$$

and $R = P - S/1{\cdot}852$. The temperature coefficient of the direct polarization of raffinose is not yet known. In constructing these equations we are obliged to assume that the polariscopic constants of raffinose upon which they depend are precise, and that the polarization of the hydrolysed raffinose is the same in the presence of ammonium chloride as it is in hydrochloric acid. Since raffinose yields levulose on hydrolysis, this assumption is obviously not correct, but the error introduced when the raffinose content is but a few per cent. is small compared with that caused by the change of acidity on the non-sugars of the beet. The formula can be made precise when the constants of raffinose are further investigated.

General considerations.—Fortunately a great advance in clarification has been made by Dr. W. D. HORNE,[2] who suggested the addition of dry basic lead acetate to the solution after making it up to volume. While Horne's method very largely eliminates the error caused by the volume of the precipitate, there remains to be specified the composition of the basic acetate of the most effective basicity. From results which we have obtained, we conclude that the basic portion of the lead salt enters more largely into the precipitate than the neutral portion. It thus happens that while the clarified filtrate usually contains an excess of lead, the latter is very nearly neutral in reaction. Since basic lead acetate solutions contain too low a concentration of hydroxyl ions to affect indicators, it is certainly without influence on the amino compounds of beet juices, which are much less sensitive to the reaction of the solution than indicators are.

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[1] It is given concisely in Browne's "Sugar Analysis," page 282.

[2] *Jl. Amer. Chem. Soc.*, 1904, 186; *I.S.J.*, 1919, 406.

We are then concerned (in the absence of invert sugar) with the effect of the clarifier upon the rotation of sucrose. We have shown that *neutral* lead acetate has an entirely negligible influence on the rotation of sucrose;[1] but Bates and Blake[2] have shown that *basic* lead acetate causes at low concentration a diminution and at high concentrations an elevation of the rotation. Consequently, it is only necessary for the analyst to assure himself that his filtrate is not basic.

In the present state of the clarification question, the greatest safety lies in the use of the minimum quantity of the reagent. It is an open question whether it is permissible to add acetic acid to the direct polarization; an excess might influence in uncertain degree the rotation of the non-sugars.

In the following table are assembled the three variables which may be encountered. It is not intended to imply that analyses performed by the prevailing methods give results which are seriously in error. The table indicates only the effect of each item individually; the collective effect can only be measured by an extensive series of comparative analyses.

(D. P. = direct polarization, made directly or acidified with acetic acid and made up to one-tenth greater volume. I. P. = invert polarization. 50 c.c. plus 25 c.c. water, or 75 c.c., made up to 100 c.c.)

Method of polarization.	Sucrose	Invert sugar in original sample.	Nonsugars of beet.
D. P. of filtrate from lead clarification I. P. in HCl solution	Constant not reproducible[3]; 142·66 erroneous[4].	Seriously affected (1) by change of concentration[5] (2) I. P. elevated[6] by HCl	Affected by change of acidity
D. P. of filtrate from lead clarification I. P. deleaded and read in HCl solution	Constant not reproducible[3]; 142·66 erroneous[4]	Seriously affected (1) by change of concentration[5] (2) I. P. elevated by HCl[6] (3) I. P. elevated by deleaded agent[7]	Affected by change of acidity
D. P. in acetic acid solution I. P. deleaded and read in HCl solution	Constant not reproducible[3]; 142·66 erroneous[4]	Seriously affected (1) by change of concentration[5] (2) I. P. elevated by HCl[6] (3) I. P. elevated by deleaded agent[7] (4) D. P. elevated by depressing effect of acetic on invert sugar[8]	Affected by change of acidity

(*To be continued.*)

A new company has been formed in Mauritius with a capital of one million rupees to import from Réunion sugar cane for crushing in the Mauritius sugar factories, as the latter can deal with more cane than their estates can supply. As the two islands are only one day's steaming apart, the cane will not suffer any deterioration, while it is considered an advantage to crush it in modern Mauritius mills rather than in the out-of-date factories which exist in many instances in Réunion.

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[1] Figures demonstrating this are given by the authors on page 164 of their *Bulletin.*

[2] *B. S. Bulletin*, 3, 105 (*Scientific Paper* No. 52).

[3] *I.S.J.*, 1920, 514.

[4] *I.S.J.*, 1920, 513.

[5] *I.S.J.*, 1920, 172.

[6] *I.S.J.*, 1920, 570.

[7] *I.S.J.*, 1920, 570.

[8] *I.S.J.*, 1920, 570.

Fifty Years Ago.

From the "Sugar Cane," October, 1870.

Wm. Arnot published in this issue a series of analyses of animal charcoal representative of the work of a number of refineries in this country and America. Several features of interest are observed in a casual glance at the tables he reproduces. Thus, it is seen that the carbon of the Clyde samples is considerably in excess of the normal proportion in good working chars, being up to 16·35 per cent.; while on the other hand the Mersey samples are lower than desirable, namely 8·2 to 9·0. On the other hand, the New York samples, although they had been in use for several years, gave 10·2 to 10·5, and those from the Thames sugar-houses showed 11·2 to 11·4 per cent. Regarding the carbonates, these are observed to range from 2 per cent. in one of the Mersey samples to 6 in those from the Thames; but the differences here are not marked by locality, as was so in the case of the carbon, but seem in a measure due to the quality of the sugars refined. Similarly, the sulphates are noteworthy, and differ widely in the various samples from about 0·1 to nearly 1·0 per cent. Alkaline salts were lowest in the case of the American samples, and lead the author to observe that this affords another proof of the care given by the New York refiners to every matter connected with the "health" of their char.

Dr. Wallace continued his paper on "Animal Charcoal" commenced in the last issue,[1] but this instalment covered very well the same ground as did his previous contribution, which we have already noticed.[2] He concluded by remarking that "it is the process of 'burning' which gradually destroys its absorbing power, and makes it 'old'...... There is no difficulty on the laboratory scale of working in renewing the original power of charcoal by removing the compounds which have been absorbed from the sugar, and the difficulties in the way of adapting these to the requirements of the refinery are probably not insuperable....."

A lecture given by Dr. **de Loos**, a Dutchman, describing the general state of the beet sugar industry in his country at that time was reproduced in this issue. Pulping and pressing were still applied as the means of extracting the juice from the roots, though it is mentioned that some factories were applying the maceration process of Schüzenbach and the diffusion process of **Robert**; and that "it is said by many of its advocates that this diffusion system yields more sugar, whereas the costs of production are much less than that in which the draining is effected by hydraulic presses, on account of the saving in labour." After carbonatation, the juice was passed over char through animal charcoal to remove "combinations of alkalis with organic acids, the small quantity of colouring matters, as well as some lime"; while after evaporation to thick juice or syrup it once more went over char. Four products were obtained.

Other articles included "Cane Culture in the Island of Reunion"; "The Imphee or Planters' Friend"; "Sugar in the Australian Colonies, does it pay?" and "The War and the Beetroot Sugar Crop." One patent was published, namely that by A. **Herbst**[3] for drying sugar in the moulds by means of air heated by passing it through a cylinder provided with tubes, through which tubes steam circulated. "As soon as the air thus warmed passes into the moulds it is subdivided into many currents, and diffused through the crystals of sugar, absorbing the moisture, and passing away at the bottom of the loaves."

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[1] *I.S.J.*, 1920, 488. [2] *I.S.J.* 1920, 12. [3] English Patent, No. 415, dated February 11th, 1870.

The Sugar Trade of United States during the Fiscal Year 1919-20.[1]

New records were made in the sugar transactions of the United States with other countries during the fiscal year ended June 30th, 1920, receipts from foreign countries and noncontiguous American territories amounting to 9,485,727,637 lbs. and shipments thereto aggregating 1,458,680,026 lbs. Furthermore, although the uneven distribution of available supplies of sugar in the United States (due in part to the transportation situation) led to high retail prices in many localities, it seemingly did not restrict the total consumption, for the average per capita consumption in continental United States for the fiscal year just ended likewise established a new record—90·6 lbs.

The total importation in the fiscal year 1920 comprised cargoes from 40 foreign countries, in addition to receipts from the Virgin Islands, the Philippines, Hawaii, and Porto Rico. As in the fiscal year 1919, when the Sugar Equalization Board stated that large quantities of sugar were bought in Cuba in 1918 by British interests, brought into the United States for refining, and then shipped abroad, similar transactions enter into the statistics for 1920. These exports and imports, however, practically counterbalance,

Large Increase in Latin American Trade.—The total imports of cane sugar into the United States, exclusive of receipts from Hawaii, Porto Rico, and the Philippines amounted to 7,532,310,606 lbs. in the fiscal year 1920, against 5,621,031,787 in 1919 and 4,944,815,410 lbs. in 1914; or an increase of 34 per cent over 1919 and of 52 per cent over the pre-war year 1914.

Cuba was the chief source of supply in 1920. The imports from that country of 6,905,709,612 lbs. broke the former high record of 5,488,711,032 lbs. in 1919. Other large increases in the number of pounds of sugar imported in 1920 over the previous year are: Dominican Republic, from 4,390,594 in 1919 to 146,638,847 in 1920; Central America, from 11,319,415 to 66,164,091; Peru, from 10,377,825 to 75,710,043; and other South American countries, from 20,849,450 to 133,158,013. The gain in the last-mentioned instance is largely due to receipts of 100,518,104 lbs. from Brazil. Mexico contributed 62,670,943 lbs. in 1920.

Other notable imports of sugar during the fiscal year just ended include 24,871,325 lbs. from Canada, 27,481,913 lbs. from Hongkong, 9,124,429 lbs. from British East Africa, and 35,722,787 lbs. from European countries. The cane sugar from Belgium, Netherlands, and England includes some items of foreign sugar refined in the United States, exported with benefit of drawback, and reimported with duty collected equal to the drawback. The greater part of the remainder from these countries consists of Java sugar.

Imports of Beet Sugar.—A new development in the sugar trade is the recent importation of beet sugar, 14,270,114 lbs., valued at $2,435,110, reaching the United States from foreign countries since January, 1920. There were no imports the first half of the last fiscal year, and only 1,180 lbs., worth $108, were imported in 1912. Of the 14,270,114 lbs. imported in 1920, 331,834 lbs., valued at $49,655 arrived in March from Belgium; 13,126,180 lbs., invoiced at $2,293,406, from Germany in June; and the remainder, 812,100 lbs., worth $92,049, from Canada, mostly during May and June. The returns credited to Germany originated in Czechoslovakia, but were shipped from the port of Hamburg. Unfortunately, some of the items included in this class were imported with cane sugar and the corrections did not reach Washington in time to make the necessary changes in the totals of beet and cane sugar imported until after the June Monthly Summary was in print.

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[1] Prepared by the Division of Statistics, Bureau of Foreign and Domestic Commerce, and published in *Commerce Reports*.

Cane Sugar Imports.—The amount and value of the receipts of cane sugar from all countries in 1920 were:—

Countries.	Lbs.	Value.
Belgium	4,829,718	$826,086
Denmark	525,460	47,067
Netherlands	13,920 918	2,460,488
England	16,446,691	2,950,535
British Honduras	2,589	313
Canada	24,871,325	3,159,142
Costa Rica	6,844,667	749,472
Guatemala	16,622,225	1,855,338
Honduras	16,558,227	1,907,305
Nicaragua	13,389,187	1,345,480
Panama	2,162,425	355,094
Salvador	10,587,360	1,296,945
Mexico	62,670,943	10,093,676
Newfoundla'd & Labrador	120,000	14,857
Barbados	391	28
Jamaica	783,816	143,046
Trinadad and Tobago	1,821,320	324,646
Other British West Indies	6,610,339	385,564
Cuba	6,905,709,612	596,275,578
Virgin Islands of U.S.	12,323,710	1,270,435
Dutch West Indies	12,515,465	1,705,693
Haiti	3,900,642	592,333
Dominican Republic	146,638,847	18,545,593
Argentina	244	33
Bolivia	3,715,474	$217,241
Brazil	100,518,104	14,396,781
Chile	476,994	89,575
Colombia	1,639,667	217,437
Brit'h Guiana	20,509,722	2,256,027
Dutch Guiana	175	18
Peru	75,710,043	8,163,713
Venezuela	6,297,633	880,586
China	2,590	264
Kwantung, leas'd territ'y	250,000	40,978
British India	2,358,701	350,198
Dutch East Indies	2,402,214	446,064
Hongkong	27,481,913	4,761,871
Japan	1,965,818	332,302
Australia	1,008	83
Philippine Islands	45,387,719	4,407,505
British East Africa	9,124,429	1,714,087
Total	7,577,698,325	684,579,477
Noncontiguous territories:		
Hawaii	1,056,623,998	118,961,556
Porto Rico	837,735,200	98,802,436
Grand Total	[a]9,471,457,523	[a]902,343,469

Arrivals of sugar from the Philippines declined from 210,950,760 lbs. in 1919 to 45,387,719 lbs. in 1920. It is understood that this decrease is offset by shipments made from the islands to China, Hongkong, and Japan. Hawaiian sugar receipts dropped from 1,215,594,766 lbs. in 1919 to 1,056,023,998 lbs. in 1920. Arrivals from Porto Rico for the last fiscal year were 837,735,200 lbs.—a material gain over the 703,286,023 lbs. received in 1919.

France the Chief Buyer of Exports.—The total domestic exports of 1,444,030,665 lbs. of sugar from the United States to foreign countries in 1920 exceed by 328,165,504 lbs., or nearly 30 per cent, the corresponding figure for 1919. There was an increase in the total value of 61 per cent—from $81,569,660 in 1919 to $131,771,308 in 1920. Exports to France of 698,798,020 lbs. broke the previous high record of 478,967,887 lbs. in 1917. Pre-war exports of sugar to France were insignificant, amounting to only 1,000 lbs. in the year ended June 30, 1914. In the six-year period since that date France has led all countries as a market for American sugar with aggregate shipments of 2,424,045,466 lbs., surpassing those to the United Kingdom of 2,154,606,913 during the same period.

The increased output of beet sugar in Europe, particularly in Belgium and Czechoslovakia, relieved to some extent the calls upon this country for cane sugar, as is shown by the decreased shipments in 1920, as compared with 1919, to Belgium, Italy, Spain, and Gibraltar, the last-named being a trans-shipment port for Near Eastern countries.

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[a] Subject to minor corrections.

Large increases in the quantity exported in 1920, as contrasted with 1919, occurred in the case of Norway, which took 74,361,248 lbs., against 17,020,101 lbs. in 1919; Switzerland, 60,193,687 lbs., against 2,268,210 lbs. in 1919; and Greece, 50,403,883 lbs., as compared with 9,328,320 lbs. in 1919. Gains on a smaller scale are shown in the sugar exports to Denmark, the West Indies, Netherlands, the Philippines. and British and French Africa. The trade with Canada has been reversed. Not only did exports thereto decline from 59,671,218 lbs. in 1919 to 965,908 lbs. in 1920, but the United States imported therefrom 24,871,325 lbs. of cane sugar and 812,100 lbs. of beet sugar during the last fiscal year.

Exports to Principal Countries in 1920.—The quantity and value of the refined sugar (including maple sugar) shipped to the principal countries in 1920 were:—

Countries.	lbs.	Values.
Belgium	11,038,605	$1,094,063
Denmark	7,002,624	651,593
France	698,798,020	62,046,336
Gibraltar	36,777,900	2,876,724
Greece	50,403,883	4,633,981
Italy	343,037	41,269
Netherlands	1,331,930	126,196
Norway	74,361,248	7,579,019
Spain	39,812,310	4,727,907
Switzerland	60,193,687	5,635,081
United K'gdm	363,236,359	31,270,809
Canada	965,908	143,180
Panama	438,650	49,538
Mexico	9,415,162	1,011,237
Newfoundla'd & Labrador	1,322,389	180,669
West Indies	2,324,876	294,190
Uruguay	11,214,800	973,395
Philippine Islands	5,353,960	572,450
British Africa	6,746,071	$1,018,262
French Africa	4,642,575	623,523
Other countries	58,306,671	6,216,886
Total to foreign countries	1,444,030,665	131,771,308
Noncontiguous territories:		
Alaska	5,566,893	701,018
Hawaii	916,220	121,037
Porto Rico	1,262,033	126,868
Re-exports of foreign sugar	6,904,215	350,310
Grand Total	1,458,680,026	133,070,541

Shipments to Alaska increased from 4,334,504 lbs. in 1919 to 5,566,893 lbs. in 1920, to Hawaii from 631,812 to 916,220, and to Porto Rico from 276,172 to 1,262,033. The re-exports of foreign sugar from the United States also rose from 3,017,199 lbs. in 1919 to 6,904,215 lbs. in 1920.

Production, Available Supply, and Prices.—The production of cane sugar in continental United States for the year 1919-20 is estimated at 241,998,400 lbs. and of beet sugar at 1,452,902,000 lbs. This production, imports from foreign countries, and receipts from noncontiguous territories, together give a total of 11,180,628,037 lbs. available in the markets of the United States. Deducting from this amount the exports from continental United States of domestic sugar, 1,444,030,665 lbs., the re-exports of foreign sugar, 6,904,215 lbs., and shipments to noncontiguous American territories of 7,745,146 lbs., makes the net amount retained for consumption in the United States 9,721,948,011. Using the revised figures of August 1st, 1920, issued by the Treasury Department, of the estimated population of continental United States of 107,239,000, this works out a per capita consumption of 90·6 lbs. in 1920, against 82 lbs. in 1919.

The average import price of sugar has increased from 2 cents per lb. in 1914 to 5·3 cents per lb. in 1919 and 9 cents per lb. in 1920. This is an increase in 1920 of 70 per cent over 1919 and of 350 per cent over 1914. The average price per lb. of sugar from Hawaii was 3 cents in 1914, 6·2 cents in 1919, and 11·3 cents in 1920, and from Porto Rico 3·1 cents in 1914, 6·8 in 1919, and 11·8 cents in 1920.

The average export price of sugar was 9 cents per lb. in 1920, against 7·3 cents per lb. in 1919 and 3·6 cents in 1914.

June the Record Price Month—New Crop Estimates.—The monthly average price of 16·1 cents for imported cane sugar was higher in June, 1920, than for any previous month in the fiscal year. From 5·6 cents in June, 1919, it rose to 6·5 cents by December, and jumped to 10 cents in January and to 12·4 cents in May of the current year. The monthly average price of refined sugar exported from the United States advanced from 7·7 cents in June, 1919, to 8·2 cents for December, dropped to 8 cents in February, rose to 11 cents in March and 11·3 cents in May, and dropped to 10·4 in June of 1920. The import price of raw sugar corresponds with the wholesale price thereof in the country from which it is shipped. The export price of refined sugar is the actual cost of the sugar at the time of exportation in the ports of the United States from which it is shipped.

The Determination of Sucrose in the Presence of both Invert Sugar and Raffinose.

By WALLACE MONTGOMERY.
Chief Chemist, Union Sugar Co., Betteravia, Cal., U.S.A.

It is only rarely that we meet with a combination of sucrose, invert sugar, and raffinose, and for the determination of the amount of each constituent both chemical and optical methods are used.

Let S = total sucrose (sucrose and invert sugar figured as sucrose); R = per cent. anhydrous raffinose; Cu = grms. of copper found in determining the total sucrose; P = polarization after inversion at 20° C.; F' = sucrose factor, obtained by dividing the Cu found in the determination of total sucrose by the corresponding amount of sucrose as given in Table A; and F'' = raffinose factor, obtained by dividing the Cu found by the corresponding weight of raffinose from Table B.

For example, on a sample of syrup, using the customary amount, 0·1628 grms., we have $Cu = 0{\cdot}209$ grms.; $P = -8{\cdot}00$.

$$\text{Then } F' = \frac{0{\cdot}209}{0{\cdot}1062^{*}} = 1{\cdot}9679;\ F'' = \frac{0{\cdot}209}{0{\cdot}147^{*}} = 1{\cdot}422.$$

From Dr. Baumann's formula[†],
$$S = \frac{582{\cdot}98\ Cu - PF''}{0{\cdot}9491F' + 0{\cdot}3266F''}$$
$$R = 1{\cdot}054\ P + 0{\cdot}344\ S$$

Substituting in above formula we have $S = 57{\cdot}13$; $R = 11{\cdot}22$.

Now, we know S includes all invert sugar originally present, so we must determine the amount of invert sugar in the original substance. This may be done by inversion and titration against Fehling's solution. In one case, however, 4·55 per cent. was present.

Remembering now that 9·5 parts of sucrose form 10·0 parts invert sugar, we calculate the per cent. of sucrose: 4·55 × 0·95 = 4·32 per cent. sucrose. Then 57·13 — 4·32 = 52·81 per cent. sucrose.

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[*] See Tables A and B for results.

[†] See WIECHMANN, "Sugar Analysis," page 104, for derivation of formula.

So in our sample we have present:

Sucrose .. .. 52·81 per cent;
Raffinose .... 11·22 „ ;
Invert sugar .. 4·55 „

Table A.

(For calculation of Sucrose from the *Cu* found, using Mohr's measure, boiling three minutes and working on 0·1628 grm. substance.)

Cu. grms.	Sucrose grms.	Cu. grms.	Sucrose grms.	Cu. grms.	Sucrose grms.	Cu. grms.	Sucrose grms.
0·079	0.0400	0·125	0·0628	0·171	0·0863	0·217	0·1105
0·080	0·0405	0·126	0·0633	0·172	0·0868	0·218	0·1111
0.081	0·0410	0·127	0·0638	0·173	0·0873	0·219	0·1116
0·082	0·0415	0·128	0·0643	0·174	0·0878	0 220	0·1122
0.083	0·0420	0·129	0·0648	0·175	0·0883	0·221	0.1127
0·084	0·0425	0·130	0·0653	0·176	0·0889	0·222	0·1132
0·085	0·0429	0·131	0·0658	0·177	0·0894	0·223	0·1137
0·086	0·0434	0·132	0·0663	0·178	0·0899	0·224	0·1143
0·087	0·0439	0·133	0·0668	0·179	0·0904	0·225	0·1148
0·088	0·0444	0·134	0·0673	0·180	0·0910	0·226	0·1154
0·089	0·0449	0·135	0·0678	0·181	0 0915	0·227	0·1159
0·090	0·0454	0·136	0·0683	0·182	0·0920	0·228	0·1164
0·091	0·0459	0·137	0·0688	0·183	0·0925	0·229	0·1170
0·092	0·0464	0·138	0·0694	0·184	0·0931	0·230	0·1175
0·093	0·0486	0·139	0·0699	0·185	0·0936	0·231	0·1181
0·094	0·0473	0·140	0·0704	0·186	0·0941	0·232	0·1186
0·095	0·0478	0·141	0·0709	0·187	0·0946	0·233	0·1192
0·096	0·0483	0·142	0·0714	0·188	0·0951	0·234	0·1197
0·097	0·0488	0·143	0·0719	0·189	0·0957	0·235	0·1203
0·098	0·0493	0·144	0·0724	0·190	0·0962	0·236	0·1208
0·099	0·0498	0·145	0·0729	0·191	0·0967	0·237	0·1213
0·100	0·0503	0·146	0·0734	0·192	0·0972	0·238	0·1218
0·101	0·0508	0·147	0·0739	0·193	0·0977	0·239	0·1224
0·102	0·0513	0·148	0·0745	0·194	0·0983	0·240	0·1229
0·103	0·0518	0·149	0·0750	0·195	0·0988	0·241	0·1235
0·104	0·0523	0·150	0·0755	0·196	0·0993	0·242	0·1240
0·105	0·0528	0·151	0·0760	0·197	0·0998	0·243	0·1246
0·106	0·0533	0·152	0·0765	0·198	0·1004	0·244	0·1251
0·107	0·0538	0·153	0·0770	0·199	0·1009	0·245	0·1257
0·108	0·0543	0·154	0·0775	0·200	0·1014	0·246	0·1262
0·109	0·0548	0·155	0·0780	0·201	0·1019	0·247	0·1268
0·110	0·0553	0·156	0·0785	0·202	0·1025	0·248	0·1273
0·111	0·0558	0·157	0·0790	0·203	0·1031	0·249	0·1279
0·112	0·0563	0·158	0·0796	0·204	0·1036	0·250	0·1284
0·113	0·0568	0·159	0·0801	0·205	0·1041	0·251	0·1289
0·114	0·0573	0·160	0·0806	0·206	0·1046	0·252	0·1294
0·115	0 0578	0·161	0·0811	0·207	0·1052	0·253	0·1300
0·116	0·0583	0·162	0·0816	0·208	0·1057	0·254	0·1306
0·117	0·0588	0·163	0·0821	0·209	0·1062	0·255	0·1311
0·118	0·0593	0·164	0·0826	0·210	0·1067	0·256	0·1317
0·119	0·0598	0·165	0·0832	0·211	0·1073	0·257	0·1322
0·120	0·0602	0·166	0·0837	0·212	0·1078	0·258	0·1328
0·121	0·0607	0·167	0·0842	0·213	0·1084	0·259	0·1333
0·122	0·0612	0·168	0·0847	0·214	0·1089	0·260	0·1339
0·123	0·0617	0·169	0·0852	0·215	0·1094		
0·124	0·0622	0·170	0·0857	0·216	0·1099		

Table B.

(For calculation of anhydrous Raffinose from the quantity of copper found, using 0·1628 grm. of sample and boiling for three minutes.)

Cu. grms.	Raffinose grms.	Cu. grms.	Raffinose grms.	Cu. grms.	Raffinose grms.	Cu. grms.	Raffinose grms.
0·0192	0·010	0·1149	0·080	0·2111	0·150	0·3079	0·220
0·0328	0·020	0·1286	0·090	0·2249	0·160	0·3127	0·230
0·0464	0·030	0·1413	0·100	0·2387	0·170	0·3356	0·240
0·0601	0·040	0·1561	0·110	0·2523	0·180	0·3494	0·250
0·0738	0·050	0·1698	0·120	0·2661	0·190		
0·0875	0·060	0·1836	0·130	0·2802	0·200		
0·1022	0·070	0·1973	0·140	0·2940	0·210		

Publications Received.

Die Polarisationsapparate und ihre Verwendung. By Dr. H. Schulz, with the collaboration of Dr. A. Gleichen. 112 pages; 80 illustrations. (Verlag von Ferdinand Enke, Stuttgart, 1919.) Price: M. 12.

Although during recent years a number of books have been published on the practical use of polarimeters, none has appeared which in a moderate size summarizes the theory, construction, and application of these instruments from the latest standpoint. Landoldt's work is, of course, well known; but owing to its size and scope it can hardly form a suitable introduction to the study of the subject. This book has been written to supply the want indicated. Part I discusses geometrical optics, and has been contributed by Dr. A. GLEICHEN[1]; and Part II, by Dr. SCHULZ, describes polarization apparatus in chapters bearing titles such as the formation of polarized light; laws relating to the rotation of light; older types of apparatus; half-shadow polarimeters; and saccharimeters (sugar scales, exterior construction of instruments, lamps and tubes, rotation determination, and practical applications).

The Mauritius Almanac and Commercial Handbook for 1920. Compiled under the direction of A. Walter, F.R.A.S., Director of the Royal Alfred Observatory, Mauritius. (The Mauritius Stationery and Printing Co., Ltd.) Price: 10 Rupees.

This publication (in its 95th year having been first issued in 1769) is a heavy quarto volume in paper covers describing all the institutions of the Colony, Tariffs, Laws, Statistics, Weights and Measures, etc. Naturally, information relating to the sugar industry is fully gone into, and there is a comprehensive list of the sugar factories. An excellent and very detailed index assists the reader greatly in searching for information.

Weights and Measures. Miscellaneous Publication 41. (Bureau of Standards, Washington, D.C., U.S.A.) 1920. Price: 10 cents.

This is a report of the 12th annual conference on the weights and measures of the United States, held at the Bureau of Standards, Washington, May 21st to 24th, 1919.

Reading List on Molasses. Clarence J. West. Bibliographic Series No. 5; 1920. (Arthur D. Little, Inc., Cambridge, Mass., U.S.A.)

Mr. WEST has compiled a list of the more important articles that have appeared during recent years in various technical periodicals on the composition, analysis, fermentation, and utilization of cane and beet molasses. He precedes his lists by some information on the general position of the production and uses of this product at the present day. As his search of the literature appears to have been a very thorough one, the publication will be appreciated at this time when much interest is being taken in molasses on account of its possible utilization as motor fuel.

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[1] Author of "Schule der Optik"; "Die Theorie der modernen optischen Instrumente"; and "Die Optik in der Photographie".

Denatured Alcohol. Treasury Decision 2986 (Treasury Department, Washington, D.C., U.S.A.) 1920. Price: 10 cents.

This discusses Regulation 61 relative to the production, tax payment, etc., of industrial alcohol, and to the manufacture, sale, and use of this spirit under Title 3 of the National Prohibition Act of the United States of October 28th, 1919.

The South African Sugar Journal Annual. (The Uba Printing Co., Ltd., Durban, Natal.) Price: 7s. 6d. net. Postage, 1s.

A well illustrated description of the Natal and Zululand sugar estates and factories compiled by the organ of the Natal sugar industry.

Fuel for Motor Transport: An Interim Memorandum by the Fuel Research Board.[1] (H. M. Stationery Office, Kingsway, London, W.C. 2.) 1920. Price 3d. (post free).

Report of the Committee of the Privy Council for Scientific and Industrial Research for the Year 1919-20. (H. M. Stationery Office, 1920.) (Cmd. No. 905.) Price: 1s. net.

La Preparación de Abonos Mezclados por el Agricultor. By F. A. López Dominguez. Circular No. 19, Insular Experiment Station, Rio Piedras, Porto Rico. 1919.

Abonos. By F. A. López Dominguez and Rafael Vilá Mayo. Bulletin No. 21 Insular Experiment Station, Porto Rico. 1919.

Dr. Oskar Wohryzek, of Diózeg, Slovakia, is bringing out a book on laboratory work and chemical control in sugar factories and refineries, in connexion more particularly with conditions prevailing in the beet sugar industry. Judging from the list of contents, this will be a book of wide scope; and judging again from the author's reputation as author of the valuable monograph entitled "Chemie der Zuckerindustrie," it is likely to be a treatise of some interest.[2] It will be published in German, and is not likely to overlap with previous volumes on the subject, viz., the well-known books by Fruhling and by Hermann. Dr. Wohryzek requests those wishing to purchase this new treatise to write to him, in order that he may have an indication of the number of copies needing to be printed.

Trade Notices.

Weston Sugar Centrifugals. (American Tool & Machine Co., 10, High Street, Boston, U.S.A.) 1920.

This interesting catalogue (published separately in English and Spanish) contains useful information in regard to centrifugal machines in general, and those made by the American Tool & Machine Co. for application in sugar manufacture and refining in particular. Information is given regarding certain of the specialities of this firm, as automatic sprayers, dischargers, lock linings, etc., while some particulars are also given of ribbon scroll conveyors. This catalogue (obtainable on request) is excellently illustrated, and also contains a considerable amount of useful reading matter.

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[1] Summary given, *I.S.J.*, 1920, 429-430.

[2] *I.S.J.*, 1914, 228.

Brevities.

The death is announced of Dr. Otto Schrefeld, who had control of the analytical laboratories of the Institut für Zuckerindustrie in Berlin.

Colloidal silicic acid (prepared by dialysing a mixture of sodium silicate and hydrochloric acid) has been found by Albert and Alex. Mary[1] to be very active in inverting sucrose.

The death is announced of Mr. James G. Thorburn, a well-known Greenock citizen, who formerly was a partner in the firm controlling the Cartsburn and Orchard refineries, and a prominent member of the sugar exchange.

The sugar estates in Cuba and Santo Domingo are attracting an increasing number of black labourers from the British West Indian colonies, especially Jamaica whence 2500 monthly are said to be going to Cuba, to work in the canefields.

In Cuba, according to the *Cuba Review*, a very considerable portion of the population is coloured—mulattos and blacks. The whites, however, are greatly in the majority. A recent census gives Cuba a population of approximately 2,900,000.

Efforts are being made in France to establish beet cultivation in certain of the departments in the south-west. Trials have been made in 1918 and 1919, the results of which are claimed to show a yield of 12 to 20 tons per acre, a sugar content of 18 to 23·5, juice purity values of 85 to 95°, and weights of 0·8 to 2·2 kg. per root.[2]

A new use of absorbent charcoals, which are applied also as decolorizing carbons, is as the catalyst for facilitating certain chemical reactions. Prof Sir W. J. Pope. F.R.S., and Prof. Chas. T. Heycock, F.R.S., both of Cambridge University, have taken out a patent[3] for the use of this material in this connexion, the particular reaction specified being the combination of chlorine with sulphur monochloride to form the dichloride.

Mr. Elie Delafond, engineer, of Havana, recently gave a demonstration of his process for the electrolytic purification of juices and syrups. He claims to have elaborated a method for the coagulation of the colloids and the separation of the salts, so that a very pure solution of sugar is obtained. This inventor states he is able to make a fine white product at practically the same cost as 96° test sugar, while obtaining a higher yield. Patents have been applied for in all sugar producing countries, and the specification will be published shortly.

August Aumann has protected a method of obtaining from the beet a juice which is free from any noxious odour or taste. His "Betavit" process[4] consists in treating the sliced roots with steam at 100–104° C. for three hours, extracting the pulp with water, and finally clarifying the juice obtained. This juice may be inoculated with a suitable yeast for conversion into an alcoholic drink. Professor A. Herzfeld, of the Institut für Zuckerindustrie, at Berlin, is stated to have given a very favourable report on this process, which has also been examined with satisfactory results by certain brewing specialists.

During the 1919 Cuban crop some experimental work on a semi-commercial scale was conducted at Central Mercedita, Cuba, on the application of the Dorr "thickener" to the clarification of limed juices. This apparatus (which has found wide use in several other industries[5]) consists of a subsiding tank provided with a stirrer carrying radial arms with plough blades set at an angle, which on slow rotation move the insoluble matter in the limed juice to a discharge opening at the bottom of the vessel. Its advantages are that a mud of greater density is obtained than by simple settling, and that consequently less filter-press area is required. It is claimed that appreciably less water is required for washing, and also that time and floor-space are economized. The results obtained have been encouraging.

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[1] *Comptes rendus*, 167, 644-646.

[2] Jean Vidal, *Bull. Assoc. Chim. Sucr.*, 1920, 37, No. 9, 371-382.

[3] U.K. Patent, 142,879 (8311), date of application May 17th, 1918.

[4] U. K. Patent, 147,713.

[5] A number of patents have been taken out relating to the Dorr "thickener," e g., U.S. specifications 1,131,222; 1,140,131; 1,227,107; and 1,237,745.

Brevities.

It is felt by the Empire Motor Fuel Committee that great damage may be done to the prospect of early production of new motor fuels if disregard is shown by the Patent Office for the known miscibility within various limits of alcohol, benzol, petrol, and other hydrocarbons.[1] The Committee wish to give warning to the investing public, that any claim to a master-patent should in any conceivable circumstances be viewed with the maximum of doubt.

At a recent meeting of the Natal Cane By-Products, Ltd., it was stated that the difficulty in obtaining adequate supplies of denaturants had been very great, and their cost had risen enormously,[2] but the new denaturant, Simonsen's Oil[3], now on order, was expected to arrive shortly. Its use is expected to improve the fuel, and eliminate the objections to which the use of wood naphtha had given rise. Realizing that there is an excellent opening for chloroform, the company has decided to import a plant for its manufacture.

Regarding the recovery of sugar from beet molasses by means of a saccharate process,[4] the liquid resulting from the use of barium oxide has the highest purity, viz., 93 per cent., as compared with 88 for strontium oxide and 81 for the calcium oxide process. The barium oxide process is in operation at Wallaceburg, Ontario, Canada, and the calcium oxide one in a number of factories in the United States, while that using strontium oxide is employed in Germany. Barium oxide recovery involves the use of an expensive electric furnace installation.

A new nitrogenous manure, "ammonium nitro-sulphate," is advocated.[5] It combines (it is claimed), the advantages of ammonium sulphate and of sodium nitrate; and contains 27 per cent. of total nitrogen, composed of 8 per cent. of nitrate nitrogen, and 19 per cent. of ammonia nitrogen. It is not a mixture of ammonium sulphate and Chili saltpetre, but is described as "a new chemical compound." Its advantages are that the transport charges per unit of nitrogen are lower than in the case of the two fertiliser-mentioned, while an economy in warehousing and application results, owing to the concentrated nitrogen content.

Mr. John A. Paine, who is connected with the United Fruit Co., of Preston, Cuba, has invented a cane cutter and harvester, capable of dealing with about 60 tons per hour. The cutting is done by a 24 in. circular saw, fitted to a revolving shaft at the head of the machine and driven by motor which is controlled by one man who can adjust the position of the saw to suit cutting conditions. The harvesting arrangement provides for a series of grips, which automatically catch the stalks of cane as it is being cut and remove the leaves by a stripping process, thence dropping the stalks of cut and trimmed cane on a conveyor which carries them back and drops them in trailer cars drawn by the tractor.

The "Balopticon," Model C apparatus, used by Mr. Geo. P. Meade, of the Cuban-American Refining Co., of Cardenas, Cuba,[6] to rapidly ascertain the size of sugar grain, is a lantern, made by Bausch & Lomb, of a type suitable for general illustrative work. It would appear that Mr. Meade's method of using it is simply to project a glass slide upon which the sugar grain has been thinly scattered. In this way, it would be possible to show upon the screen in the dark-room a fair amount of grain at one time, and it would be easy at the same time to project an image of 10 diameters, the magnification of course being dependent upon the focus of lens used and the distance at which the apparatus is placed from the screen.

Some further particulars of Mr. Kestner's process of making beet concrete sugar are available.[7] Lime in powder is added to the diffusion juice at the rate of 2 to 5 grms. per litre, and also a small amount of decolorising carbon (which may be either a high-power preparation analogous to "Norit", or simply wood charcoal), the liquid being subsequently boiled. It is then possible to pump the juice through filter-presses. After concentration to about 60° Brix in a Kestner effect (the first bodies of which work under pressure and the last under vacuum), the syrup goes into a "finisher" in which while stirring it is transformed into a fine-grained mass containing 6- 7 per cent. of water. This "sucre concrete" or "sucre complet" has a titre of 86- 88°, and contains about 3 per cent. of ash. It is stated to be very suitable for certain grades of confectionery, e.g. caramels and cheap bon-bons, and for ordinary chocolate.

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[1] See also *I.S.J.*, 1920, 402-405. [2] *I.S.J.*, 1919, 519.

[3] Einar Simonsen, of Sköien, near Christiania, in 1913, patented a denaturant consisting of the distillate obtained from crude mineral oil below 300° C. (German Specification 285,190). Presumably, this is what is being sold under the name of "Simonsen's Oil."—Ed., *I.S.J.*

[4] "Reading List of Molasses." C. J. West. (A. D, Little, Inc., Cambridge, Mass., U.S.A.)

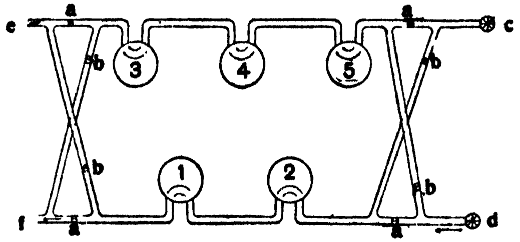
[5] *Deutsche Zuckerindustrie*, 1920, [illegible], No. 32, 432-433. [6] *I.S.J.*, 1920, 525-526.

[7] *I.S.J.*, 1920, 440-441. [8] *Bull. Assoc. Chim. Sucr.*, 1920, 37, No. 9, 382- 389.

Review of Current Technical Literature.[1]

COUPLING-UP JUICE HEATERS FOR THE PREVENTION OF INCRUSTATION IN SULPHITATION FACTORIES. F. *van Vollenhoven*. *Archief voor de Suikerindustrie in Nederlandsch-Indië, 1920, 28, No. 23, 918-922.*

In Java tubular heaters are used for raising the temperature of the untreated raw juice to 65–70°C. and that of the limed and sulphited juice to about 105°C. About 1912 HARLOFF[2] suggested that the incrustation occurring in the battery devoted to the limed and sulphited juice might be diminished by being used also for the untreated juice, in which the precipitate should dissolve to a great extent. This matter was also discussed by VAN DER LINDEN[3]; and now the result of putting the idea into practice at Petaroekan is described, much trouble from this source having formerly been experienced in this factory.



In the sketch the method of operating is clearly shown. When all the valves at *a* are open, and those at *b* are closed, the arrangement is such that the untreated juice entering at *d* goes through the heaters *1* and *2*, and the limed and sulphited juices entering at *c* pass through *3*, *4* and *5*, leaving at *f* and *e* respectively. On the other hand, when the valves at *b* are open, and those at *a* are closed, the raw juice entering at *d* goes through the heaters *3*, *4* and *5*, and the limed and sulphited juice entering at *c* flows through numbers *1* and *2*. Advantages of this method of working, compared with the ordinary procedure, are obviously that less labour is required for cleaning (the heaters remaining clean for 3–5 days instead of 24 hours); that the wear and tear of apparatus is lessened; that there is a more economical use of the steam; and lastly that there is a better use of installation, since all the units may be in operation at the same time. In order to examine the principle upon which the method is founded, a weighed amount of sulphite scale (dried) was heated in raw juice at 65–70°C. for at least 2 hours, at the end of which time the liquid was filtered, and the residue washed and dried. About 50 per cent. of the weight of the sulphite scale had thus gone into solution.

CRYSTALLIZERS, THEIR OPERATION. R. C. *Pitcairn*. *Paper read before the 17th Annual Meeting of the Hawaiian Chemists' Association.*

Regarding the cooling of the massecuite while in motion in crystallizers (of the circular water-jacketted type), the temperature curve resembles very much the expansion line of a good indicator card as far as the point at which the exhaust begins to open. At this latter stage it has generally reached a temperature of 38°C. in 72 to 96 hours, when water can be added. If the apparatus is provided with a water jacket, cold water can first be turned on, and in 12 hours the massecuite will have dropped to about 32°C. Repeated readings show the reduction of the temperature to be very uniform throughout (the speed being 1 revolution in 2 minutes), and a difference of 2°C. is the most that can be detected. Ordinarily in an 800–1000 ton house, a crystallizer is filled every 18 hours, and with 12 of these apparatus in use the massecuite will have at least 8 days to be treated, and will be cooled to 38°C. by the sixth day, when water can be added directly but slowly in a fine stream at the rate of 0·5 gall. per hour.

It is imperative that the crystallizer should not be flooded, otherwise some of the grain will be remelted as the result of the movement; but if run in slowly, the water will be immediately absorbed, so that the massecuite will soon free itself, losing the heavy gummy appearance so often characteristic of low grades. Water can also be used with beneficial results if pumped into the massecuite slowly and the massecuite kept in motion till it enters the centrifugal machines. Two per cent. can be added in this way, and it will wonderfully increase the purging qualities of the massecuite, but it is necessary that movement should be maintained. In no case has the use of steam been found advantageous by the author, and he believes it better to add water than molasses.

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[1] This Review is copyright, and no part of it may be reproduced without permission.—(Editor, *I.S.J.*)

[2] *Archief*, 1912, 1006.

[3] *Ibid.*, 1916, No. 42.

A New Carbonaceous Decolorizing and Clarifying Agent. *A. Herzfeld. Deutsche Zuckerindustrie, 1920, 45, No. 26, 360-361.*

It consists of a fine black powder, which on being heated in a platinum dish volatilizes without odour, leaving behind a considerable amount of ash, the following analytical figures being obtained: Moisture, 4·57 per cent.; lost on ignition, 19·13; silica, 58·89; iron and alumina, 14·92; lime (CaO), 0·52; total ash, 75·63; sulphuric acid (SO_3), 0·76; and phosphoric acid (P_2O_5), 0·54 per cent.; the acidity of the sample corresponding to 1·66 per cent. of CaO. Striking is the high content of silica, and the low loss of ignition which is doubtless due mostly to carbon. Decolorizing tests, using a dark beet after-product sugar, showed that while good bone char removed 90 per cent. of colour, the values for "Carboraffin" and the new preparation were 94 and 74 per cent. respectively,[1] a result that is regarded as favourable. It is suggested that this product may find use, not only as a decolorizing agent, but as a clarifying material, since it consists mostly of a substance corresponding in composition to kieselguhr, and may also possess the activity of this earth for clarification purposes. In regard to the treatment of the scums in respect of their improved filtration, it has been pointed out by the author[2] that preference should be given to materials containing some ferrous sulphate, since this constituent appears to arrest the colloidal condition in which the calcium carbonate may be present. The price of this material is given as 2500 Mks. per ton, including packages.

Theory and Practice of Lubrication: The "Germ" Process. *Henry M. Wells and James E. Southcombe. Journal of the Society of Chemical Industry, 1920, 39, No. 5, 51-60T.*

In a paper read in London before the Society of Chemical Industry, and in Pittsburg before the National Petroleum Association of America, the authors explained the rationale of the superior lubricating properties of fatty oils, and of oils compounded with oils, over "straight" mineral oils (i.e., uncompounded mineral oils), which property had previously been mentioned, but hitherto has remained undeveloped. They have demonstrated that liquids which "wet" solid surfaces are lubricants; while those that do not cannot be regarded as such; that one property which differentiates them is capillarity or interfacial tension; that the fatty acids in fatty oils perform the function of lubrication, not the fatty oils *per se*; that if the fatty acid be extracted from a fatty oil it is little if any better than a mineral oil as lubricant; and lastly that if a fatty acid in small quantities be added to mineral oils, their lubricating properties are very appreciably enhanced. Results in the laboratory demonstrating these points have been confirmed by several independent authorities.

On the practical side, the authors cite many examples where fatty oils, or oils compounded with fatty oils, have been entirely and successfully replaced in actual practice by their "germ process" oils for the lubrication of steam engines (including those of the Corliss type), gas and oil engines, and many other kinds of mechanism. On filing their patent[3] for oils made by this new process in February, 1918, its "publication or communication" was immediately prohibited by the British Admiralty, who carried out trials over many months on about 15 ships of the mercantile marine, with results that were quite satisfactory. "Germ process" oils are cheaper than fatty compounded oils, and are suitable for the heaviest work in all climates. It should be explained that the title "germ process" is a purely arbitrary one, being selected chiefly owing to the fact that hitherto there has been some apprehension in associating the word "acid" with any oil used for lubrication, an apprehension grounded on a complete misunderstanding of its physical and physico-chemical functions.[1]

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[1] "Carboraffin" has a much higher decolorizing power, at least five times greater than the best bone char (also finely ground). Ed., *I.S.J.*

[2] *Zeitsch. Ver. deut. Zuckerind.*, 1909, II, 753.

[3] U.K. Patent, 130,377; U.S. Patent, 1,319,129; *I.S.J.*, 1920, 478.

Question of the Destruction of Sucrose during the Boiling of Low-grade Massecuites.

Henry L. White. *Report of the 17th Annual Meeting of the Hawaiian Sugar Chemists' Association.*

First molasses was boiled at 140–145° F. (60–63° C.) and 26·5 in. vacuum, and the following figures were obtained, leading the author to conclude that there is no appreciable loss of sugar in the working of low-grade massecuites under the conditions generally obtaining in Hawaii.

	Molasses entering pan.			Molasses leaving pan.		
	Molasses, in tons.	Brix, in tons.	Sucrose, in tons.	Massecuite, in tons.	Brix, in tons.	Sucrose, in tons.
1.	45,118	35,327	19,459	36,811	35,247	19,771
2.	49,282	37,933	21,245	40,016	38,675	21,361
3.	48,648	38,262	20,826	39,191	37,741	20,736
4.	49,973	38,129	20,989	39,703	38,512	20,578
5.	47,660	38,937	19,746	38,339	36,997	19,817
Total		188,588	102,265		187,172	102,263

"The fact that the tons of sucrose going in and the tons of sucrose coming out agree so closely is not attributed to the accuracy of the work altogether, but more logically to a coincidence of figures." Laboratory experiments are also described showing that when higher temperatures than those named are used, viz, 165–172° F. (74–78° C.) there may be a considerable loss of sucrose; while others confirmed the general idea that when the low-grade pan is kept at a temperature slightly below 150° F. (65·5° C.) there is no appreciable loss during boiling owing to decomposition.

Time required for the Crystallization of Second Massecuites in Motion.

H. D. Beveridge. *Report of the Seventeenth Annual Meeting of the Hawaiian Chemists' Association.*

At Onomea, T.H., during the 1919 crop a series of observations were made for the purpose of definitely determining the length of time second massecuites should remain in motion for complete crystallization. Boiling took place in a calandria pan having a capacity of 650 cub. ft., and a heating surface of 376 sq. ft., the pressure of the exhaust steam being 4 to 6 lbs.; the vacuum, 27 in.; the temperature, 140–145°F. (60–63°C.); and the time of boiling, 24 to 28 hours. Crystallizers of the covered type without water jackets were used. One strike and one cut were made to each crystallizer, or approximately 900 cub. ft. per crystallizer.

It was found that desugarization occurred after the first four or five days, the decrease of purity during the seven days subsequent amounting to only 0·5°. Initially, the purity of the massecuite in the pan was 54·9° (gravity), and the temperature 63°C.; while that of the molasses drained off was 40·4°, a fall of 14·5° having thus taken place. After remaining five days in the crystallizers, the purity had decreased to 32·0°, the temperature being 37°C. At the time of striking from the pan, the Brix, sucrose, and purity values were 96·6, 52·99, and 54·86 respectively; and when emptying the crystallizers they were 96·52, 52·90, and 54·81. Very little, if any, loss of sucrose had therefore occurred in the crystallizers in the case of these massecuites boiled at a low temperature.

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[1] Further particulars of this process can be obtained of the Henry Wells Oil Co., 11, Haymarket, London, S.W.1.

Review of Current Technical Literature.

LOSS OF SUCROSE BY INVERSION DURING THE HEATING OF SECOND MASSECUITES AND FINAL MOLASSES. *R. C. Pitcairn. Report of the Seventeenth Annual Meeting of the Hawaiian Sugar Chemists' Association.*

Samples of second massecuite and final molasses from seven different mills in Hawaii were heated to 65°C. (149°F.) for varying periods, determinations being made initially and finally of the gravity purity and the acidity (by titrating with N/28 alkali, using phenolphthalein, and expressing the result as grms. CaO per cent.).

Results were obtained indicating that there is a very decided danger of inversion while boiling the low-grade products if they are not kept nearly neutral. A massecuite having an acidity corresponding to 0·25 grm. CaO per cent. is considered to be in danger of losing sucrose by inversion during boiling; but in the case of molasses, owing of course to its lower purity, the risk would be less. The loss of sucrose that may occur in this way is capable of reaching an important degree, and probably can account for a proportion of the so-called "unknown losses." Thus, a drop in purity of 2° caused by inversion will correspond to a loss in available sugar of over 5 per cent. of that present, which would have a value of a good many thousand dollars in the average factory during the year's run. It is therefore suggested that a standard system of controlling the acidity should be elaborated for routine application in Hawaiian mills, covering the stages from mixed juice to final molasses.

DETERMINATION OF REDUCING SUGARS BY THE IODIDE VOLUMETRIC METHOD. *Herman A. Spoehr. Publication No. 287, Carnegie Institution of Washington, 31–36.*

Among the most important factors influencing the accuracy of the volumetric procedure (a careful study of which has been made by E. PFLUEGER[1] and A. W. PETERS[2]) may be mentioned: (1) The attack of the asbestos filter by the alkali of the Fehling's solution; (2) the self-reduction of the copper liquor; and (3) the contamination of the cuprous oxide with substances which are not easily determinable, and for which a correction cannot readily be applied. Furthermore, in the case of many plant extracts (especially those resulting from cacti, which were under investigation by the author when writing this article), mucilaginous substances greatly impede the filtration, making it possible for re-solution of the cuprous oxide to occur. It is therefore desirable sometimes to use a method which does not depend upon the determination of the cuprous oxide and which does not involve its filtration.

Rapid and reliable results were obtained by centrifuging in order to separate the precipitate, the amount of Fehling's solution remaining unreduced being found by the iodide process. 10·0 c.c. of Fehling's solution (or more in some cases) were placed with a known volume of the sugar solution under examination in a stoppered tube having a constricted bottom, which tube is immersed in a boiling water-bath for 4½ min. At the end of this time, the tube is cooled as rapidly as possible to 15°C. and the volume completed to the mark (generally 50 c.c.) with recently-boiled distilled water. After replacing the ground-glass stopper and mixing, the tube with the others in the series is placed in a small laboratory centrifuge and revolved for 5 mins. at about 1700 revs. per min. It is then found that the precipitate of cuprous oxide with any other solid or suspended matter is thrown down in a compact mass in the narrow bottom of the tube.[3]

It now remains to determine the copper in the unreduced Fehling's solution; and this is done by transferring an aliquot portion by means of a pipette into 150 c.c. Erlenmeyer flasks and acidifying with sulphuric acid (using 1 c.c. of the concentrated reagent to every 10 c.c. of Fehling's solution present, the mixture being then cooled). Potassium (or sodium) iodide is added, and as the reaction runs to completeness only when there is present a considerable excess of this reagent, about 0·5 c.c. of a cold saturated solution of the iodide to each c.c. of the original copper solution remaining is used. Finally, as usual the liberated iodine is titrated with N/20 or N/50 sodium thiosulphate, and a freshly prepared solution of soluble starch is used as indicator, the mixture towards the approach of the end-point assuming a very light brown or lavender colour changing to a very faint pink when the last drop has been added. This procedure is stated to be well adapted for routine work, and the various stages involved, viz., measuring out the solutions, heating, centrifuging, cooling and titrating, can be apportioned to two or three operators when a large number of determinations are being made.

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[1] *Arch. Ges. Physiol.*, 1898, 69, 399–471. [2] *J. Amer. Chem. Soc.*, 1912, 34, 928–954.

[3] If any cuprous oxide adheres on the sides of the tube, the solution can be clarified by shaking and re-centrifuging.

DETERMINATION OF PENTOSE SUGARS. *Herman A. Spoehr. Publication No. 287, Carnegie Institution of Washington, 36–37.*

Tollen's method has found very general application, and is based upon the partial conversion of the pentoses into furfural by distilling with mineral acid, the amount of furfural being found gravimetrically by precipitation with phenylhydrazine or phloroglucinol, or volumetrically by titration with phenylhydrazine, Fehling's solution, or sodium bisulphite. None of these methods is without serious error, and all are unreliable in a quantitative sense, according to the author. Thus, it has been found that 12 per cent. hydrochloric acid is not without effect on the furfural; that the amount of furfural varies with the proportion of pentose originally present, a special co-efficient having to be applied for all concentrations; and that the condensation products with phenylhydrazine and phloroglucinol are not altogether insoluble. Moreover, when hexoses and many other substances (as starch, cellulose, oxycellulose and glucuronic acid) are also present in the extract, they decompose to a greater or less extent with the formation of furfural.[1]

In view of these facts, it is considered that the only reliable method of estimating pentoses must be based on their separation from other constituents accompanying them. So far, fermenting away the hexoses seems to be the most practical way of doing this, using a good culture of bakers' yeast, after which (when the alcohol has been eliminated) the cupric reducing power of the residue is ascertained. Experimental mixture of l-arabinose or l-xylose with dextrose and sucrose showed the latter sugars to be removed while the pentoses were unaffected. It is, of course, necessary to make certain that the non-fermentable residue is actually composed of pentoses, and not of some other non-fermentable sugar, as, for example, the interesting d-mannoketo-heptose, recently described by LA FORGE,[2] which is occasionally present in plants.

YELLOW LIGHT SOURCE IN POLARIMETRIC OBSERVATIONS. *Luis Gugliamelli. Anal. Soc. Quim. Argentina, 1918, 6, 497–499; Journal of the Chemical Society, 1920, 118, No. 693, ii, 444.*

To obviate the drawbacks of the use of sodium chloride, DUPONT[3] proposed a mixture of sodium chloride and trisodium phosphate, which the author has found to work very satisfactorily. For its preparation, one gram-molecule of disodium phosphate is dissolved in water and treated with one gram-molecule each of sodium hydroxide and chloride. This solution is evaporated to dryness, and the residue fused.

PREPARATION OF SUCROSE FROM GENTIANOSE. *Emile Bourquelot and M. Bridel. Comptes rendus, 1920, 171, No. 1, 11-15.*

Gentianose is a trisaccharide (extracted from gentian roots with 95 per cent. alcohol) formed of two molecules of *d*-glucose and one of *d*-fructose with the elimination of two molecules of water. It has been found that total hydrolysis may be effected by acting upon it first with the enzyme emulsin from almonds and then with the enzyme invertase from yeast. With emulsin alone, it is the glucose that is attacked, and it may be separated in the state of β-methyl glucoside, leaving sucrose which may be obtained by crystallization in a pure condition. Attempts were made 20 years ago to effect this reaction; but these failed owing to the action of the emulsin being insufficiently long continued. Invertase also was found to act very much more slowly upon sucrose in a combined than in a free state.

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[1] See *I.S.J.*, 1919, 355. [2] *I.S.J.*, 1918, 41. [3] *Bull. Soc. Chim.*, 1897, 17, 584.

Organization of Chemical Control in the American Beet Sugar Industry.

S. J. Osborn. Journal of Industrial and Engineering Chemistry, 12, No. 8, 803- 805.

In the Great Western Sugar Co. (which owns some 16 factories) the chemical control work is directed by a special department, entirely independent of the operating staff, though naturally both work in close co-operation in order to achieve the best results. This chemical department is responsible for almost all the operating reports (other than financial), and keeps a detailed set of records for the purpose. It secures the necessary data for the calculation of the extraction losses, being further responsible for the testing of the automatic beet scales and for the weighing of the molasses. The head is the General Chemist, under whom are five Travelling Chemists, each of whom has supervision over the work at three or four contiguous factories, and under him again is the Chief Chemist of the factory. There are three Assistant Chemists at every factory, one on each shift, and under him are bench chemists, analysts, rasp-men, boiler-house control men, and samplers.

It is stated that the chemical personnel at a single factory numbers 22 to 42, working in 8-hour shifts. At each factory in 24 hours the number of determinations made include: polarizations, 200-300; apparent purity, 156-200; Brix, 125; alkalinity, 175-225; lime in press cake, 60; and naphthol tests, 225.

Prevention of the Deterioration of Raw Sugar by Treating in the Centrifugals with Superheated Steam.

Nicholas Kopeloff. Journal of Industrial and Engineering Chemistry, 1920, 12, No. 9, 860- 862.

Shorey [1] has suggested the use of superheated steam in the centrifugals as a means of preventing the deterioration of raw sugar, which practice has also been recommended by Owen[2]. In order to test the value of the proposal, large crystals were sterilized and coated with blackstrap molasses heavily inoculated with micro-organisms, as *Aspergillus* Sydowi Bainier, *A. niger*, *Penicillum expansum*, *B. vulgatus*, *B. megatherium*, *B. mesentericus*, and bacterial colonies developing from plates poured from Cuban sugar. This massecuite after being heated to 104°F. (40°C.) for about 10 minutes, was poured into the basket of a laboratory centrifugal, which was put into operation, the maximum speed attained being 3,000 revs. per min. Steam at a temperature of 263F. (128°C.) was then turned into the basket for about 3 min., at the end of which treatment the temperature of the sugar was found to be 155°F. (68°C.).

Bacteriological examination subsequently showed that a diminution of 99·47 per cent. of the bacteria and 98·28 per cent. of the molasses originally present had resulted; while in the case of the molasses the figures were found to be 84·23 and 50·00 per cent. respectively. Incidentally, the sugar was as white, if not whiter, than that washed with water (which is frequently of questionable character and often responsible for inoculation with micro-organisms). Under mill conditions it may be anticipated that even better results would be obtained, higher temperatures being available. It has been shown by the writer[3] that in the deterioration of raw sugar two factors operate, namely (1) the moisture ratio or factor of safety; and (2) the degree of infection. If, therefore, the mass infection is reduced by treatment with steam in the centrifugals, in the manner indicated, the keeping quality may be greatly increased, even when the moisture is higher than it should be. For example, a sugar having a moisture ratio of 0·08 will deteriorate when 10,000 to 100,000 mould spores per grm. are present; but a reduction of 98 per cent. would bring the count to about 1000 per grm., a value which would make the sugar safe, even though the moisture were as high as 0·14 to 0·16.

J. P. O.

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[1] *I.S.J.*, 1898, 549.

[2] *I.S.J.*, 1919, 339.

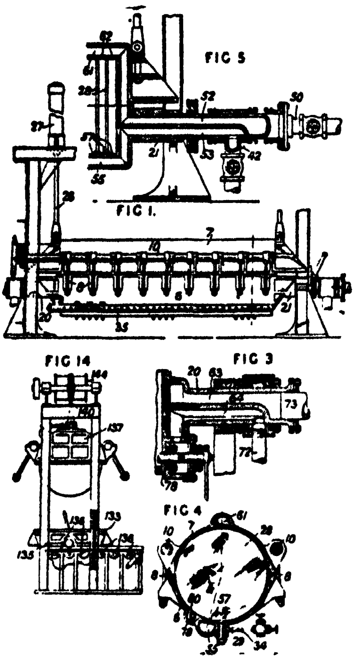
[3] *I.S.J.*, 1920, 282.

Review of Recent Patents.[1]

UNITED KINGDOM.

Casing of a Leaf Filter. *United Filter Corporation* (assignees of *E. J. Sweetland*), of New York, U.S.A. *144,278* (*14,800*). May 31st, 1920; convention date, May 18th, 1916: *not yet accepted;* abridged as open to inspection under Section 91 of the Act.

The casing of a leaf filter is formed in two parts which can be separated and one of which is mounted on trunnions through which liquid is supplied to and discharged from the casing. In the arrangement shown in Figs. 1 and 4, the lower and upper sections *6*, *7* of the casing are clamped together by swing bolts *8* mounted on cams carried by shafts *10* which are geared to turn together. The upper section 7 can be raised by means of steam or hydraulic cylinders *27* and tension rods *26*. The filter leaves *28* are held in place by means of discharge nipples *29* which communicate through pipes *34* with an outlet manifold *35*. The interior of the trunnion *21*, Fig. 5, is divided into two passages *52*, *53* communicating respectively on the one hand with pipes *50*, *42*, through which material can be supplied to the filter, and on the other with the interior of the casing through passages *61*, *55* and apertures *62*, *57*. A passage *63* in the trunnion *20*, Fig. 3, connects the manifold *35* with a discharge pipe *73* and a passage *64* connects a pipe *72*, through which a washing fluid is supplied to a rotatable sluicing pipe *78* provided with nozzles *80* to direct the fluid across the filter leaves. The pipes *42*, *50* may be used simultaneously for supplying material, or circulation through the filter may be secured by using one for supply and the other for withdrawal. To discharge the separated solid matter the upper section *7* is raised and the lower section *6* turned over on the trunnions, either manually or by gearing automatically operated by the raising of the section *7*. Modified apparatus is described in which the upper section is normally stationary and the lower section is moved down before it is turned over. Fig. 14 shows a further modification in which the filter leaves are suspended in the upper section *137* of the casing, this section being supported by cables *140* wound on a drum *144*. Solid matter adhering to the leaves can be discharged into a receptacle below, after the lower section *133*, which is mounted on a carriage *135*, has been moved aside on rollers *136*.



Motor Fuel containing Alcohol. *U.S. Industrial Alcohol Co.*, of New York. *144,052* (*11,418*). May 7th, 1919; June 10th, 1920.

It consists of a petroleum distillate such as gasolene or kerosene, ethyl, methyl, or other alcohol, benzol, toluene, anthracene, or other aromatic hydrocarbon, and a phenol such as cresol. Nitrobenzol or other aromatic nitro-compound may be added.

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[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States:* Commissioner of Patents, Washington, D C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 2fr. 00 each).

Roasting Cocoa Beans. *M. Pannevis*, of Utrecht, Holland. *143,224* (*12,956*). May 10th, 1920; *not yet accepted; abridged as open to inspection.*

Cocoa beans are roasted in receptacles heated by a surrounding liquid, as glycerin, which is maintained at or near its boiling point.

Juice Extraction using Electro-Osmosis. *Elektro Osmose Akt.-Ges.* (*Graf Scherwin Ges.*) of Berlin. *145,045* (*16,113*). January 9th, 1915; *not yet accepted; abridged as open for inspection under Section 91 of the Act.*

During the extracting or washing of vegetable and other substances, an electric current is passed through them, so that the liquid is carried through in a direction dependent upon the electro-positive or electro-negative character of the material.

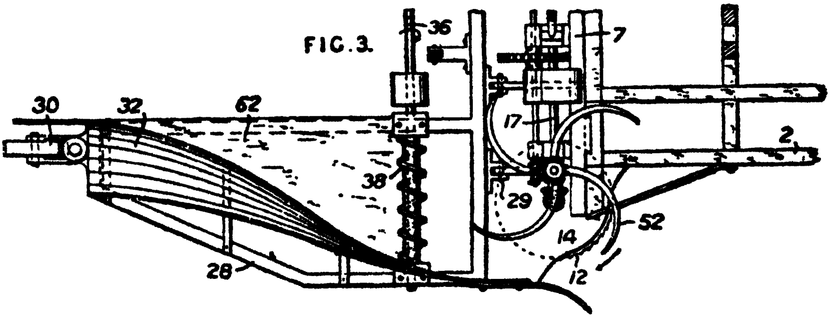
Water Tube Boilers. *Stirling Boiler Co., Ltd., and Henry J. S. Mackay. 146,050* (*32,807*). December 31st, 1919; July 8th, 1920. (Two figures.)

There is provided in the feed drum or drums a feed box or boxes enclosed by partitions so as to form a water-tight compartment or compartments from which the water can pass down a portion of the adjacent bank or banks of tubes to the associated mud drum, and an imperforate diaphragm or partition in conjunction herewith in the associated mud drum or drums in such manner that the water can flow both downwards and upwards within the bank or banks of tubes farthest from the grates, a baffle or baffles being interposed between the bank or banks farthest from the grate and the other bank or banks associated with the same steam and water and mud drums as to form two passes.

Machine for Harvesting and Windrowing Cane. *Henry O. Scranton*, of Jeanerette, Iberia, La., U.S.A. *144,904* (*18,113*). July 21st, 1919; June 24th, 1920. (Four figures.)

This machine is specially useful when the temperature approaches the freezing point, as it enables the cane to be sent down expeditiously and laid in straight longitudinal rows or piles between the rows of plants with the tops covering the stalks, in order to preserve them from the cold. It comprises a truck *2* mounted on two wheels or runners, or on two wheels provided with runners. Vertically adjustable legs hold the truck level when the windrower is removed. The crop is cut by circular saws or cutters *12* provided with stationary guards *14*, and mounted in a frame *7* which is adjusted vertically by means of a lever, etc. The cutters are driven by bevel gearing from a shaft *17* driven from a motor by belt gearing. The windrower frame *28* is pivoted at *29* and supported by castor-wheels *30*. To facilitate turning, the frame *28* may be raised by means of a lever. The plants are moved laterally by curved guides *32*, and spiral conveyors *38* arranged as shown above bottom plates *62*. The conveyor shaft *36* is driven by belt gearing from the shaft *17*. The plants are tilted backwards as they are cut by spider wheels *32* driven from the shaft *17* by spur and worm gearing. Means may be provided for adjusting each cutter separately. A machine may be provided with a single cutter and windrower; and the crop may be delivered on to a stripping-machine.

FIG.3.



YEAST. *A. Wohl and S. Scherdel*, of Danzig. *145,623* (*17,797*). June 29th, 1920; convention date, January 15th, 1914; *not yet accepted; abridged as open to inspection under Section 91 of the Act.*

An improved yeast is obtained by growth in a medium which contains over 10 per cent. (and preferably not more than 50 per cent.) of inorganic nitrogen, such as ammonia, the remaining 90 per cent. (or less) of nitrogen being in the organic form. The inorganic ingredients are preferably added gradually.

STARCH. *J. Kantorowicz*, of Breslau. *145,689* (*17,961*). June 30th, 1920; convention date, May 31st, 1918; *not yet accepted; abridged as open to inspection under Section 91 of the Act.*

To prevent the formation of lumps when the kind of starch that swells in cold water is made into a paste with water, a substance is added which either delays the swelling of the starch, or thickens starch paste, or precipitates starch from aqueous solution. Examples of substances which delay the swelling of starch are magnesium and sodium sulphates; suitable thickeners are aluminium compounds, feebly alkaline salts such as borax or sodium phosphate, tannic acid and its salts, boric acid, and salts of fatty and resin acids; whilst magnesium salts are given as examples of suitable precipitants. Specifications *3415* of 1910 and *9082* of 1912 are referred to.

NITROGENOUS PHOSPHORIC FERTILIZER. *Nitrum Akt.-Ges.*, of Zurich. *146,097* (*15,708*). June 10th, 1920; convention date, June 28th, 1919; *not yet accepted; abridged as open to inspection under Section 91 of the Act.*

It is obtained by heating tri-calcium phosphate with at least an equal quantity of nitric acid (preferably of 50-60 per cent. strength), mono-calcium phosphate and calcium nitrate being formed. To the thin paste obtained sufficient limestone or other calcium compound or phosphate is added to neutralize the free acid, and convert the mono-calcium phosphate into mono-hydrogen calcium phosphate. The product obtained is allowed to solidify and is then pulverized.

EVAPORATOR. *E. Barbet and Fils & Cie.*, of Paris. (1) *114,838* (*5232*). March 25th, 1918; September 4th, 1919. (2) *117,070* (*8821*). May 28th, 1918; August 5th, 1920.

A tubular evaporating apparatus is described of the type in which the liquid passes upwards through a number of tubes, and the vapour passes through the spaces intervening between the sheaths and the tubes. The method consists essentially in causing the vapour in contact with the walls to circulate rapidly through a passage of small cross-sectional area for the purpose of increasing its co-efficiency of transmission through the wall, returning the fluid not thereby condensed, and again causing it to pass through the spaces intervening between the sheaths and the tubes. The second patent consists of an improvement of the first, in which the bundles of tubes are so spaced as to allow dispensing with the use of sheaths, while obtaining the desired velocity, and in preferably employing a fan or blower as the means for effecting the circulation of the vapour through the space between the tubes.

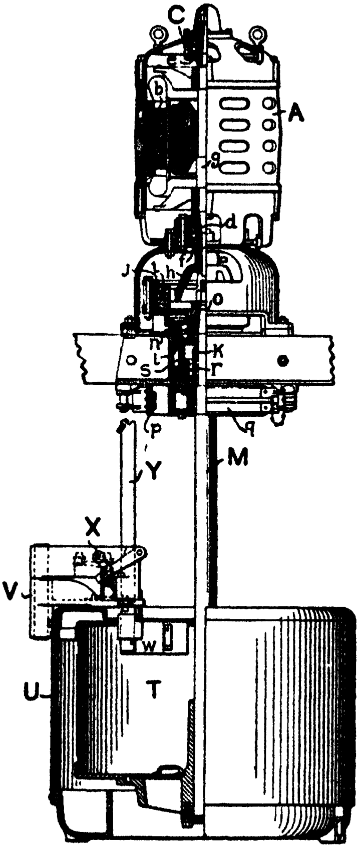
EVAPORATING AND COOLING SYRUPS, FRUIT JUICES, ETC. *A. Rambaud*, of Vaucluse, France. *144,631* (*15,019*). June 2nd, 1920; convention date, June 10th, 1919; *not yet accepted.*

It consists of one or more horizontal rings from which fabric cylinders are suspended, together with liquid-distributing devices by which the hot liquid is fed through nozzles on to the top of the cylinders, the cylinders or the liquid-distributing devices being rotated.

UNITED STATES.

ELECTRIC DRIVE FOR CENTRIFUGAL MACHINES. *Edward D. Mackintosh*, assignor to *S. S. Hepworth Co.,* of New York. *1,342,405.* November 11th, 1918; June 1st, 1920 (one figure).

When using an electric motor, especially an induction motor, the problem is to obtain about 1000 r.p.m. when running, and only about 20 when discharging by means of mechanical unloaders. Braking down the induction motor from the higher speed, or giving it two windings, is impracticable. In this invention, the desired result is achieved by using a two-speed motor and employing the form of drive that connects the motor to the machine by means of a centrifugal friction clutch.



As here illustrated, the electric motor *A* has its winding *b* (for either direct or alternating current) of such nature as to afford a multiple speed drive, preferably one at about 1200 r.p.m., and the second at about 600 r.p.m. The motor shaft *g* is vertical and runs in upper and lower ball bearings *C* and *d* located in oil chambers *e* and *f* respectively. At the lower end of the motor shaft *g*, and below the bearing *d* is secured one element, viz., the spider *h*, of a centrifugal clutch. The spider carries a group of swinging or sliding blocks *i* which, when the motor is rotated, are thrown outward into engagement with the clutch ring *j*. The latter is bolted to the clutch plate *o*, which in turn is clamped rigidly to the head of the shaft *M* of the centrifugal basket *T*. The relation of the clutch blocks *i* to the ring *j* is such that they do not engage the latter until the motor is well under way, and even at the lower speed of the motor the torque exerted by the clutch is only about ¼ that exerted when the motor is at high working speed. The slip of the blocks on the ring at low speed of the motor is therefore a matter of no great moment from the standpoint of wear or overheating of these parts. The support for the shaft *M* of the centrifugal basket may be of any suitable construction, but is here shown as of the type disclosed in a co-pending application.[1] It comprises a ball-bearing *l* mounted in a cup *s* which is supported in the frame of the centrifugal through the ball and socket joint *r*, so as to permit the basket *T* to swing slightly.

The unloader plough *w* is carried by bracket *R* mounted on the centrifugal basket casing *U*, and is lowered and lifted by means of its rack bar *Y* engaged by a pinion on the shaft of the crank handle *X*. The usual brake drum *p* is fast on the upper portion of the shaft *M* and is engaged by the brake band *q* in well-understood manner to halt the basket when desirable. When the discharger plough *w* is swung by the operator into engagement with the material lining of the interior of the basket, it exerts a drag upon the latter which causes the friction clutch to slip, and thus drops the speed of revolution to that convenient for unloading (about 20 r.p.m.). The extent of the drag thus exerted by the plough is wholly under the control of the operator, since the more rapidly the plough is lowered the greater the drag, and vice versa. By a proper manipulation of the plough, the necessary regulation of the drag is attained to secure the proper discharge speed of revolution of the basket. Of course the operator may at any time resort to the additional control afforded by the brake, but this is not ordinarily required.

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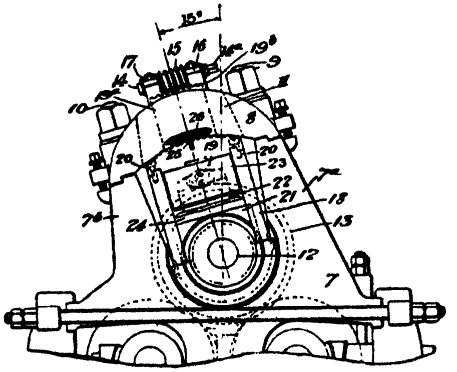
[1] Serial, 296,908, filed May 13th, 1918.

MILL PROVIDED WITH MEANS FOR ALTERING THE ANGLE AT WHICH THE HYDRAULIC JACK OPERATES. *John J. Armstrong*, of Honolulu, T. H. *1,213,573.* August 10th, 1915; January 23rd, 1917. (Six figures.)

It is desirable that hydraulic jacks should operate at the angle to the vertical corresponding with that of the line representing the resultant of the spreading strains between the rollers. As this inclination from the vertical is not the same in all mills, due to the varying conditions under which the mills operate, means have been provided for altering the angle at which the hydraulic jacks operate. The invention is in the nature of improvements in mills of the type shown in U. S. Patent 1,106,301, issued in 1914 to C. J. Hedemann; but while it is possible to change the angle of applied hydraulic pressure in this type of mill, yet it is not an easy matter to accomplish this adjustment.



Referring to the drawing, the upper portion of the housing *7* is inclined to the vertical, preferably about 15°, and its jaws *7a* and *7b* are tapered upwardly, so that the gap between them is made wider at the top, near the cap *8*, than heretofore. The cap *8* is secured to the jaws *7a* and *7b* of the housing *7* by the bolts *9* and *10* respectively or otherwise. The cap *8* is provided with the vertical slot *11*, and its bottom is curved to the arc of a circle struck from or near the axle *12* of the top roller *13* as a centre. The shaft *14*, provided with the square end *14a* for turning the shaft by means of a wrench, and with the worm *15*, is journaled in the boxes *16* and *17* above the cap *8* and over the slot *11* as shown. The lower portion *18* of the frame is adapted to fit and be seated in the semi-circular bottom of the gap between the jaws *7a* and *7b*. The upper portion *19* of the frame, which is secured to the upper ends of the lower portion *18* by the screws *20*, is curved to fit the bottom of the cap *8*, and is provided with a lug *19a* which projects upward towards the slot *11* in the cap *8*, and terminates in the segment of a worm-gear *19b* which is adapted to mesh with the worm *15*. The top roller journal brass *21* is adapted to be guided by and to slide within the lower portion *18* of the frame with the movement of the top roller *13*. The ram *22* of the hydraulic jack *23* engages the steel shoe *24* which distributes the pressure upon the top roller journal brass *21*. The top of the hydraulic jack *23* engages the bottom of the upper portion *19* of the frame, and is connected in the usual manner with a hydraulic accumulator.

It will now be noted that the frame may, when the pressure is off the ram *22*, be easily and quickly turned in the gap between the jaws *7a* and *7b* about the axis *12* by turning the shaft *14*; that the angle to the vertical at which the hydraulic pressure is to be applied may thus be easily and quickly increased or diminished; and that the frame is automatically locked by the worm *15*, and the worm-gear segment *19b* in the desired position when thus adjusted. The angle of inclination from the vertical may be read by means of the scale *26* attached to the upper portion *19* of the frame and to the top cap *8* respectively.

APPARATUS FOR MACERATING BAGASSE. *Noël Deerr.* of Brooklyn, N.J. *1,346,594.* November 20th, 1917; July 13th, 1920. (See United Kingdom Patent, 126,093[1].)

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[1] *I.S.J.*, 1919, 414.

UNITED KINGDOM COMPLETE SPECIFICATIONS ACCEPTED.

Production of Acetone and Alcohol. *C. Weizmann. 149,355 (2786).* February 24th, 1916.

Manufacture of Starch and its Conversion Products. *A. W. H. Lenders. 149,374 (6512).* March 5th, 1919.

Liquid Fuel. *E. C. R. Marks U.S. Industrial Alcohol Co.). 149,398 (11,420)* May 7th, 1919.

Heat Exchange Apparatus. *E. Harter. 127,565 (11,289).* May 25th, 1918.

Recording Specific Gravity. *F. L. Halliwell. 149,448 (12,479).* November 17th, 1919.

Manufacture of Yeast from Molasses and Beet Pulp. *L. J. P. M. J. Dupire. 149,438 (12,020).* May 13th, 1919.

Treating Fruit Juices. *J. G. F. Hieber. 149,537 (22,844).* September 17th, 1919.

Nitrogenous Fertilizers. *Norsk Hydro-Elektrisk Kvaelstofaktieselskab. 139,462 (3990).* February 24th, 1919.

Beet Harvesters. *G. Saur. 149,462 (19,042).* May 23rd, 1919.

Evaporators. *S. M. Dick. 150,007 (3046).* February 7th, 1919

Apparatus for Wrapping Cakes and Confectionery. *Rose Bros. and H. Rose. 150,076 (13,499).* May 28th, 1919.

Aeroplane Motor Fuel. *U.S. Industrial Alcohol Co. 128,917 (15,126).* June 25th, 1918.

Fermentation Process. *C. Weizmann. 150,360 (7552).* May 25th, 1917.

Production of Saccharic and Tartaric Acids from Carbohydrates. *Diamalt Akt.-Ges. 108,494 (11,302).* August 4th, 1916.

Shaking Tables for Confectionery. *National Equipment Co. 150,538 (22,677).* September 15th, 1919.

Sugar Boiling. *Ballochmyle Creamery Co. 150,588 (31,741).* December 18th, 1919.

Evaporators. (1) *Metallbank u. Metallurgische Ges. 140,059 (3896).* March 13th, 1919. (2) *F. Merz. 150,785 : 150,786.* June 4th, 1919.

Beet Harvesters. *Morse Hammerwerk Akt. and R. Neilsen. 150,345 (24,586).* November 1st, 1917.

Water-Level Indicator. *Pneumercator Co. 150,699 (25,038).* August 28th, 1919.

Confectionery Coating Machines. *National Equipment Co. 150,799 (14,321).* June 5th, 1919.

Cleaning Sugar Beets. *Weller Mfg. Co. 150,828 (14,773),* June 11th, 1919.

Elastically Centred Bearings of Centrifugal Machines. *Wolseley Sheepshearing Co., J. T. Walton, and G. Picken. 150,892 (20,229).* August 18th, 1919.

Automatic Recording of Mill Clearances. *Naamlooze Venootschaap Suiker-Cultuur Maatschappij. 150,959 (25,978).* September 9th, 1919.

Fertilizers. *J. R. Partington and L. H. Parker. 151,024 (10,528).* June 26th, 1918.

Manufacture of Fodder from Straw. *E. Beckmann. 151,229 (20,134).* April 25th, 1917.

Purifying Solutions. *Elektro-Osmose Akt.-Ges. 151,002 (24,945).* September 11th, 1919.

Centrifugal Machine Lubrication. *H. Holte. 151,273 (26,316).* September 17th, 1919.

Sugar Crops of the World.

(Willett & Gray's Estimates of Crops to September 16th, 1920.)

	Harvesting Period.	1919-20. Tons.	1918-19. Tons.	1917-18. Tons.
United States—Louisiana	Oct.-Jan.	108,035	250,802	217,499
Porto Rico	Jan.-June	433,825	362,618	413,958
Hawaiian Islands	Nov.-July	505,500	538,913	515,035
West Indies—Virgin Islands	Jan.-June	12,000	9,000	5,400
Cuba	Dec.-June	3,750,000	3,971,776	3,446,083
British West Indies—Trinidad	Jan.-June	55,000	47,850	45,256
Barbados	,, ,,	50,000	80,000	65,230
Jamaica	,, ,,	46,875	43,000	34,300
Antigua	Feb.-July	16,667	12,841	9,409
St. Kitts	Feb.-Aug.	10,036	10,901	8,846
Other British West Indies	Jan.-June	10,000	10,000	16,745
French West Indies—Martinique	Jan.-July	22,000	10,027	20,881
Guadeloupe	,, ,,	31,000	26,604	30,382
San Domingo	Jan.-June	150,000	158,309	127,322
Haiti	Dec.-June	5,000	3,300	....
Mexico	,, ,,	85,000	60,000	40,000
Central America—Guatemala	Jan.-June	15,000	13,441	22,809
Other Central America	,, ,,	20,000	15,000	10,000
South America—				
Demerara	Oct.-Dec. and May-June	96,000	107,560	108,181
Surinam	Oct.-Jan.	12,000	8,000	9,739
Venezuela, *exports*	Oct.-Dec.	18,000	15,000	10,751
Ecuador	Oct.-Feb.	7,000	7,000	8,000
Peru	,, ,,	300,000	300,000	253,176
Argentina	May-Nov.	250,000	130,266	87,699
Brazil	Oct.-Feb.	187,000	183,079	148,958
Total in America		6,195,938	6,375,287	5,655,659
Asia—Brit. India (consumed locally)	Dec.-May	3,001,000	2,370,000	3,311,000
Java (1920-21, 1,460,000)	May-Nov.	1,335,763	1,749,408	1,778,345
Formosa and Japan	Nov.-June	283,482	415,678	397,618
Philippine Islands, *exports*	,, ,,	203,000	195,289	216,260
Total in Asia		4,823,245	4,730,375	5,703,223
Australia	June-Nov.	175,000	209,853	324,260
Fiji Islands	,, ,,	60,000	80,000	70,800
Total in Australia and Polynesia		235,000	289,853	395,060
Africa—Egypt (consumed locally)	Jan.-June	90,000	75,899	79,488
Mauritius (1920-21, 240,000)	Aug.-Jan.	235,490	252,770	226,000
Réunion	,, ,,	40,000	50,000	50,000
Natal	May-Oct.	150,000	185,000	106,250
Mozambique	,, ,,	36,000	20,620	43,478
Total in Africa		551,490	584,289	505,216
Europe—Spain	Dec.-June	3,000	6,618	7,039
Total cane sugar crops		11,808,673	11,986,422	12,266,197
Europe—Beet sugar crops		2,676,049	3,705,708	4,293,956
United States—Beet sugar crop	July-Jan.	652,957	674,892	682,867
Canada—Beet sugar crop	Oct.-Dec.	16,500	22,300	11,250
Total beet sugar crops		3,345,506	4,402,900	4,988,073
Grand total Cane and Beet Sugar	**Tons**	**15,154,179**	**16,389,322**	**17,254,270**
Estimated decrease in the world's production	**,,**	**1,235,143**	....	....

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

	One Month ending September 30th.		Nine Months ending September 30th.	
	1919. Tons.	1920. Tons.	1919. Tons.	1920. Tons.
Unrefined Sugars.				
Russia	....	....	....	...
Germany	....	....	....	5,964
Netherlands	....	....	1	....
Belgium	....	....	....	....
France	....	....	....	....
Austria	....	....	....	....
Java	7,501	70,825	153,501	95,480
Philippine Islands	....	....	1,738	....
Cuba	9,144	291	426,824	506,570
Dutch Guiana	....	....	1,252	59
Hayti and San Domingo	....	14	....	14
Mexico	....	....	....	....
Peru	9,870	2,382	48,393	31,815
Brazil	595	33	4,816	6,159
Mauritius	52	276	114,658	102,583
British India	511	1,204	3,043	16,056
Straits Settlements	....	....	....	....
British West Indies, British Guiana & British Honduras	8,275	2,584	98,681	121,337
Other Countries	907	2,375	12,289	31,257
Total Raw Sugars	**36,855**	**79,983**	**865,196**	**917,293**
Refined Sugars.				
Russia	....	....	....	....
Germany	....	....	....	126
Netherlands	1,562	2	10,917	1,065
Belgium	....	75	2,620	2,113
France	....	....	23	24
Austria and Hungary	....	....	....	123
Java	24,020	....	98,144	5,010
United States of America	53	1,601	143,273	100,391
Argentine Republic	....	5	9	40
Mauritius	25	....	16,302	....
Other Countries	1,666	436	47,365	7,676
Total Refined Sugars	**27,327**	**2,119**	**318,653**	**116,569**
Molasses	18,557	2,006	88,618	57,833
Total Imports	**82,739**	**84,108**	**1,272,467**	**1,091,695**

EXPORTS.

	Tons.	Tons.	Tons.	Tons.
British Refined Sugars.				
Denmark	....	....	....	....
Netherlands	....	....	....	2
Portugal, Azores, and Madeira	....	....	....	....
Italy	....	....	....	....
Canada	....	....	1	....
Other Countries	62	160	932	686
	62	160	933	688
Foreign & Colonial Sugars.				
Refined and Candy	395	653	2,098	2,800
Unrefined	6,900	986	27,061	7,917
Various Mixed in Bond	....	....	....	....
Molasses	329	155	4,337	2,766
Total Exports	**7,686**	**1,954**	**34,429**	**14,171**

Weights calculated to the nearest ton.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1920. Tons.	1919. Tons.
Total Receipts January 1st to September 30th	2,520,994	2,381,041
Deliveries ,, ,,	2,509,756	2,378,041
Meltings by Refiners ,, ,,	2,176,031	2,347,000
Exports of Refined ,, ,,	325,000	355,000
Importers' Stocks, September 30th	11,238	3,000
Total Stocks, September 30th	10,432	11,490
	1919.	1918.
Total Consumption for twelve months	4,067,671	3,495,606

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1917-1918, 1918-1919, AND 1919-1920.

(Tons of 2,240 lbs.)	1917-18 Tons.	1918-19. Tons.	1919-20. Tons.
Exports	2,586,960	2,782,443	3,130,357
Stocks	556,251	813,072	327,032
	3,143,211	3,595,515	3,457,389
Local Consumption	73,700	66,000	62,700
Receipts at Ports to July 31st	3,216,911	3,661,515	3,520,089

Havana, August 31st, 1920.

J. GUMA.—L. MEJER.

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR NINE MONTHS ENDING SEPTEMBER 30TH, 1913, 1919, 1920.

	IMPORTS.			EXPORTS (Foreign).		
	1913. Tons.	1919. Tons.	1920. Tons.	1913. Tons.	1919. Tons.	1920. Tons.
Refined	668,058	318,653	116,569	672	2,098	2,800
Raw	772,277	865,196	917,293	3,006	27,061	7,917
Molasses	115,351	88,618	57,833	238	4,337	2,766
	1,555,686	1,272,467	1,091,695	3,916	33,496	13,483

	HOME CONSUMPTION.		
	1913. Tons.	1919. Tons.	1920. Tons.
Refined	659,975	290,945	132,455
Refined (in Bond) in the United Kingdom	546,479	622,016	610,276
Raw	90,067	232,534	160,408
Molasses	23,020	33,381	22,800
Molasses, manufactured (in Bond) in United Kingdom	26,867	52,816	56,574
Total	1,346,408	1,231,692	982,513
Less Exports of British Refined	18,723	933	688
	1,327,685	1,230,759	981,825

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Notes and Comments.

The Cuban Sugar Crisis.

The sugar market is largely dominated by the situation in New York, Cuba and Java, where not only speculators but regular buyers have come a big cropper the last two months owing to being unable to dispose of their purchases save at a loss. The American refiners are reported to have been heavily hit, and their contracts with inland buyers at the old high prices have been a source of considerable difficulty inasmuch as the buyers have tried to get out of their contracts with the refiners, and the latter have endeavoured to minimize their losses by spreading out deliveries as much as possible. But the losses in any case are stated to be heavy. In all, the American sugar operators are supposed to have lost 200 million dollars.

A month ago we commented on the much stronger position held by the Cuban producers, and reported how the holders of the balance of the 1919-20 crop were refusing to sell at existing prices and insisted on waiting for the recovery of the market at the end of the year. But the unexpected has happened in Cuba, for the banks who had loaned heavily on stocks of sugar became financially embarrassed through the great fall in the value of their security and in some cases had to suspend payment; and to prevent the panic spreading the President declared a fifty-day moratorium to give the sugar interests time to arrange affairs without precipitating forced sales of sugar.

How this crisis came about is conveniently summarized by the *Federal Reporter*, which in a recent issue remarked that with the great prosperity that came to Cuba with high prices, it is incomprehensible to many how there should now be any financial embarrassment; this is, however, understood when it is realized that the sugar mills, who purchase their cane from the planters do so on the basis of the price of sugar at the time the cane is delivered. If delivery was on a high market and the sugar manufactured, instead of being sold, was carried forward, it must now be disposed of on a low market whereupon the mills sustain a very serious loss. The chief losers have been the banks who loaned freely on sugar at too high a price, and the mills which did not sell their sugar when they had an opportunity to. The bulk of the planters as a rule have done wonderfully well, as they sold their cane to the factories at prices based on high sugar quotations, and the average return has been a handsome one. In order not to jeopardize the prospects of the new crop, certain American banking interests have since concluded a 75 million dollar loan with the Cuban Government against Government bonds, and this loan is expected to stabilize the market and will probably sober new crop prices.

Meanwhile, it may be remarked, the Cuban 1919-20 crop has terminated with a total output according to GUMA & MEJER of 3,730,077 tons, or 241,699 tons less than in the previous season. These figures are only slightly lower than the crop forecast given in our August issue by our Cuban correspondent, who then put the probable total at 3,750,000 tons.

The Prospect of Supplies.

With the bottom knocked out of the attempted Cuban cornering of supplies, and a drastic fall in the prices on the Java market, where the previous quotation of round 45 guilders has quickly dropped to as low as 30 guilders, sales are everywhere being forced and supplies may be counted on to come forward more freely. But the financial situation is not without anxiety for the sugar industry, since if the embarrassed parties do not succeed in surmounting the crisis, the effects may be inconveniently far-reaching and might affect the future production.

For the consumer, however, the outlook is distinctly pleasing, as there seems now every prospect that supplies will be reasonably plentiful, though it must not be overlooked that once prices fall below a certain level a demand will set in from the poorer sections of the world consumers that might speedily result in renewed scarcity. What that level is, only experience will show, but so long as the world's consuming capacity (given a reasonable price) greatly exceeds its producing capacity, there is always a risk that any big drop in the price of sugar will send up consumption with a bound and after it the prices themselves. If this eventuality is avoided, the balance of price and supply will be more easily stabilized.

At home a temporary restriction in sugar supplies was enforced for a fortnight during the coal strike (that has now fortunately been settled on terms that offer considerable possibilities of economic peace); but with transport once more normal, the expected decrease in the control prices of sugar makes a start on November 15th when retail prices are being reduced to 1s. per lb. for Granulated.[1] The ration remains at 12 oz. per head per week; but it would not occasion surprise if an early increase to 1 lb. were announced. Alternatively, the Royal Commission may see fit before long to remove altogether the rationing which at present only applies to white sugars, and allow the public to buy as they please: the price is still too high to encourage any marked increase in the consumption. But the control of the market by the Sugar Commission and the maintenance of maximum prices is hardly likely to be discontinued for some months, and we anticipate that the Royal Commission will not finally go out of office before next Spring or even Autumn.

The Java Sugar Crop.

By October 15th, more than half the Java sugar factories had finished their crop, while the remainder will be through within a few weeks. The results have been satisfactory so far, and indeed much better than was anticipated. According to cabled information received in Holland, the average yield of sugar to the date just mentioned amounted to 122 piculs of standard muscovado per bouw. Java has planted in 1920 219,642 bouws with cane, and if the final result remains as it is now, the total output (calculated in standard muscovado) will be 26,785,324 piculs or 1,650,000 tons. But since over half of the crop is delivered as white sugar, the actual weight of sugar is less than its equivalent of raw. We estimate the actual production at 1,600,000 metric tons.

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[1] See page 607 for details of the change in prices officially announced.

The weather has been favourable for the grinding and the work has so far proceeded without much interruption. The labour leaders at one moment threatened a general strike, in case their rather far-reaching claims were not complied with, but notwithstanding the refusal of the manufacturers to meet their demands the work has been continued, apart from a few isolated strikes of short duration, and the season ends at the usual time of the year. It can, as yet, not be accurately recorded to what destination this year's crop is going. The sugar has been sold and re-sold so many times between the date of the first purchase and the present day, that we do not know its final destination, while shipping statistics later than June are not yet available.

The Question of the Distance between Cane Rows.

In the October number of this journal we published the first part of an interesting paper by A. H. ROSENFELD on "The question of the Distance between Cane Rows," and the second part of this long paper is included in the present issue. We trust that the length of this communication will be condoned by our readers because of the importance of this factor in plantation work. The details of the newer agricultural practice in the cultivation of sugar cane in the Argentine are instructive, but we doubt whether these descriptions, which savour of repetition, might not have been abbreviated with advantage. The paper as a whole appears to be a strong piece of special pleading for the five-foot row. It may be that this is insisted on because of local disbelief in its merits, but we have formed the opinion that, considering the great differences in the growth of varieties of the cane, the time they are in the ground, and the enormous antitheses in climate and other conditions in the sugar growing countries of the tropics, a somewhat wide latitude should be allowed as to how much soil should be provided for each cane stool. With this proviso, five feet is a very good distance, and has been more or less adopted in a great many places; and the main consideration in its favour, which is strongly insisted on by the writer of the paper, is that, while not leaving the land bare too long, it is possible to cultivate the soil between the rows with modern tractors or horse and cattle drawn implements. With the gradual extension of sugar cane estates to countries and places where the labour supply is inadequate for proper cultivation, this is a very important matter.

There are some other points in the paper which may conveniently be referred to in passing. There would appear to have been no attempts in Rosenfeld's experiments to apply the principle of duplicate plots, now considered so important a safeguard in comparative field work. It is true that this defect is partly guarded against here by the number of instances given, and in some cases it would have been impossible because of the size of the fields, but the results would have been more convincing if some duplicate plots had been introduced. Some of the conclusions also do not carry conviction. To give an instance, the Zwinga and Kavangire (Uba) tables would not appear to give such strong support as the writer claims. The tonnage of canes in Uba decreases more or less with the distance of the rows, while the outturn of sugar shows a more marked increase in both varieties (a point not mentioned by the writer). We do not see that the author is justified therefore in claiming, as he does, that the yield of cane and sugar per acre is, in these varieties, approximately equal at any distance up to seven feet. There is in this a suspicion of what we may term the "artistic" the world's oil supplies, the less demand there is for the light petroleum distillates on the part of those industrial centres that can profitably produce denatured alcohol, the better it will be for the others who depend chiefly on the oil products.

The West Indian Tropical Agricultural College.

As we mentioned in our last issue, the venue of the projected West Indian Tropical Agricultural College is to be in Trinidad. Further details of the scheme[1] show that the site chosen is on Government land at St. Augustine, about six miles out of Port of Spain ; it will stand on a spacious pasture of about 60 acres in extent. Within one-third of a mile of the College site are one of the Experimental Stations and the Government farms of the Trinidad Department of Agriculture. At the former about 150 acres are reserved for experimental work, some 61 acres being already used for large scale plots of sugar cane and other plants. The college will thus be in a position when erected to start immediately, under very favourable conditions, practical work and research in connexion with the principal West Indian crops.

The Colonial Secretary, Lord MILNER, invited the College Committee last month to resume its labours, and that body on meeting unanimously decided that the promises and prospects of support by the Legislatures of the various West Indian colonies were sufficient to justify them in proceeding with the necessary steps towards the establishment of the College. Those colonies which have so far promised aid are Barbados, Trinidad and Tobago, Grenada, St. Vincent, St. Lucia and the Leeward Islands. It is hoped also that British Guiana, Jamaica, and British Honduras will when the matter is brought before them officially approach it in a broad minded way and give assistance to the scheme. As our contemporary remarks, the next step will presumably be to nominate a provisional governing body and to incorporate the College and, provided that no time is lost, it would now appear to be reasonably certain that the British West Indies will be ahead of Ceylon and other eastern British colonies in establishing a much needed Tropical Agricultural College.

New Areas under Sugar Cane.

The high prices which sugar is fetching are resulting in the extension of existing areas of sugar cane cultivation or in the inauguration of the industry in territories that hitherto have not produced sugar, unless in very crude form for local consumption. Other things equal, it is more promising to open up continental territory than island areas, since if the industry flourishes there is bound to be more room for expansion. The British West Indies as sugar colonies suffer from the restricted size of their island components. So to much the same degree does Hawaii. Java and Cuba are really island continents by comparison. If it could be found possible to open up territory say in British Africa for instance, there might be much scope for a big production. Again, the possibilities of Central and South America are only now being adequately realized. It is true that pioneers in these vast areas are confronted with endless tracts of forest land which it may or may not pay to clear ; but we venture to think that in spite of these obstacles there remains enough open ground to offer a very extensive addition to the world's existing areas of cultivated land.

Venezuela is a case of a Continental state where there are indications of an appreciable effort being made to extend the sugar industry and export the product to the world's markets. Sugar is grown all over this country, but in pre-war days the production was little more than the needs of the consumption, and six years ago the export was but three thousand tons, sent to nearby destinations. Now there are three modern centrals in existence and four or five others are contemplated. The largest is Central Venezuela, which during the 1920-21 season will have 7200 acres under cane and expects to turn out 15,000 short tons of sugar. Another factory is Central Azucarero del Zulia which has an output of about 6000 tons, while a third factory known as the Central Gran Via, which is the newest of the three, has a still smaller production. All three are situate in the district of Sucré, State of Zulia. Based on Cuban practice this may look a small output, but it seems to be only a beginning, and further factories as above mentioned are projected which may result in the Venezuelan sugar industry exporting much more than the 18,000 tons that it sent overseas during last season.

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[1] For which we are indebted to the *West India Committee Circular.*

Among other regions holding out promise of developing the sugar industry, one may mention Tabasco, a Mexican state about one-third the size of Cuba, which has a soil said to be similar to the Cuban one. The climate is also similar, and canes grow luxuriously and ratoon for years, while this sugar belt is easily accessible to the markets of the world; it therefore offers possibilities which may be developed in the near future.

Finally mention may be made of the Dominican Republic, where the basin of the Yaque River is reported to be a very productive region, given means to irrigate the soil from the river. As to its suitability for cane sugar production, local opinion seems very favourable. Cane has already been grown on a small scale and crops of 50 to 60 tons per acre have been easily harvested. Outside capital is however wanted for any development here, as the Republic has none available for the purpose.

Royal Commission on the Sugar Supply.

November Prices.

The Food Controller announces the following complete list of revised sugar prices for the four-weekly period from November 1st to November 27th, 1920. It will be noticed that the approved retail price for rationed white sugar is reduced by 2d. per lb. as from Monday, 15th November.

	For Grocery Purposes White Vouchers Only			For Manufacturing Purposes and Ships' Stores Coloured Vouchers
	Wholesale per cwt Discount 1¼ per cent. to direct buyers.	Approved retail price per lb.		
Class.		1st Nov. to 14th Nov	15th Nov. to 27th Nov.	Wholesale per cwt Discount 1¼ per cent. to direct buyers.
0. Castor, Icing, Pulverized	102s.	1s. 2¾d.	1s. 0¾d.	102s.
1. Cubes, Loaf Sugar	100s.	1s. 2½d.	1s. 0½d.	100s.
2. Granulated, Crystals, Crushed and Chips, Dry White Sugar, White Pieces (moist)	96s.	1s. 2d.	1s. 0d.	96s.
3. W. I. Grocery Crystallized Yellow Crystals, W. I. Muscovado (moist), Pieces (other than White W. I. Grocery Syrups)	Free of Voucher Price must not exceed that fixed for Licenced Free Sugar	Free of Ration	Free of Ration	Free of Voucher
4. Jellies, Knots, Lumps, and other Low Grade sugar to be sold only to manufacturers	—	—	—	Uncontrolled

The wholesale prices quoted are those at which sugar will be supplied to direct purchasers by the Commission or by refiners.

Beet Prospects on the Continent.

(By Our Continental Correspondent)

The prospects of the present beet sugar campaign on the Continent are very bright. The spring put in an early appearance and was favoured by sufficient rainfall that made the seed germinate and the young plants thrive very satisfactorily. In most of Western Europe the summer was rainy, but in France, Italy, and Eastern Europe drought prevailed, though, fortunately, not to such an extent as to cause damage of any significance. The autumn has been very fine, the days uncommonly warm and sunny, and the nights cool, a combination that has contributed to the accumulation of much sugar in the roots. The campaign has started about a fortnight earlier than last year, and the first reports speak of high sugar contents and a fair weight of the roots. The writer has just come back from a trip through the principal beet growing districts of Western Europe, and was glad to see how rapidly the work was proceeding. The beets are being pulled without difficulty, owing to the brilliant autumn weather and the dry condition of the fields and of the country roads. For the first time since 1914 one has seen smiling faces in the European sugar-houses, and that is a feature worth noticing.

Germany.—The German statisticians stick to their estimate of 1,100,000 tons for 1920-21, provided that all of the beets harvested are actually worked up in the sugar factories, and provided the latter are kept supplied with the necessary fuel, and that at the proper time to work the beets up without delay. The Commissioner for the coal supply in Germany wants the sugar manufacturers to use more brown coal than previously, but this will necessitate heavy expense in altering the furnaces, erecting fresh chimneys and even increasing the boiler capacity. All this will take time, so that for this campaign it will be impossible to comply fully with the desire of the coal authorities.

If the price for the beets, which has officially been fixed at 20 marks per 50 kg., is sufficient to induce the growers to cart all their roots to the sugar factories, and if the latter succeed in obtaining the necessary fuel to extract the sugar, Germany will produce between 1,100,000 and 1,150,000 tons, calculated as raw. Last season (1919-20) the country consumed only 931,300 tons of sugar, while in 1918-19 the German sugar consumption was 1,327,700 tons. It is obvious that as soon as the production allows a higher ration, the German people will be permitted a larger sugar consumption than was the case last year. The total German sugar production will therefore be needed to supply the wants of the country, so no exportation can be expected. On the other hand, the price of sugar on the world's market, expressed in marks, is so prohibitive that very likely Germany will not either import any appreciable quantities. In the very unfavourable 1919-20 season, when the German production amounted to only 717,875 tons, the country did not import more than 57,349 tons, so that in the present campaign no imports will be needed at all.

Czecho-Slovakia.—The first inquiry among the Czecho-Slovak sugar manufacturers showed that they estimated the present crop at 738,000 tons of sugar, calculated as raw, or equivalent to 650,000 tons of refined. The home consumption is estimated at 300,000 tons, which leaves an amount of 350,000 tons for export. In the first six months of 1920 this country exported 90,300 tons of sugar, chiefly to Austria, France, Germany, Italy, Hungary, Poland, and Sweden. In the second half of this year 40,000 tons of Czecho-Slovak sugar will be exported to Switzerland, while the destination of the balance will be France, Austria, the Balkan countries, and perhaps also the United Kingdom.

Beet Prospects on the Continent.

Hungary.—The prospective sugar production of Hungary is estimated at 45,000 tons, which is almost sufficient for the wants of that country, and only requires an importation of 1000 tons (coming from Peru) to supply all needs for the coming campaign.

Austria.—Austria is only making some 5000 tons and will have to depend on imports from Czecho-Slovakia, with which state it has entered into an agreement for the purchase of the necessary sugar. In 1919 Austria consumed 128,032 tons of sugar, of which 103,181 tons were imported from Czecho-Slovakia, and it is believed that similar figures will hold good also for 1920.

Russia.—Reliable reports from Russia are still lacking; in case some item of news filters through, we never can tell whether the information relates to some minor part of the vast country or has a more general bearing. One must therefore refrain from saying anything on the subject concerning Soviet Russia and the Ukraine.

Poland.—Reports from Poland speak of estimates of 210,000 tons, calculated as raw, for the total production, of which quantity 150,000 tons will be produced by the ex-Prussian provinces. Last year Poland consumed 140,000 tons, hence, if we assume a similar figure for this year, it leaves a surplus for export of 70,000 tons.

Holland will certainly produce 320,000 tons of sugar, calculated as raw. Including the sugar used for the manufacture of exported sugared goods, the annual consumption will amount to 200,000 tons. At all events, the Government has reserved that much for the total home use. If the estimate, corresponding to 290,000 tons of refined, is reached, the country will be able to export 90,000 tons of white sugar. It is not yet clear where this sugar will go, but of late years the United Kingdom, Switzerland, France, Belgium and Germany have been the recipients; of these, the last two will not this time be included in the list.

Belgium.—The sugar production of Belgium is estimated at 225,000 tons, or again in excess of the consumption of the country. In 1919-20, Belgium consumed 170,000 tons, against 100,000 in 1918-19. There is no reason why we should assume a higher consumption this year, so an export of about 55,000 tons of raw may be looked for.

France has planted this year 80,000 hectares with beets, the crop is doing very well and experts expect a tonnage of 26,445 kg. of beets per hectare. The total production is estimated at between 250,000 and 300,000 metric tons of sugar, calculated as refined, that is to say dependent on the question how much of the beet crop goes to the distilleries and how much to the sugar factories. During the past year France consumed about one million tons of sugar, or about double the amount in 1918-19. On 1st September, 1920, there was only a stock of 5348 tons, while it is not probable that the invisible stocks will have been large at that date. Even if we consider part of the alleged consumption to have passed over into invisible stocks and not to be reckoned among the real consumption, the home production, even if it attains 300,000 tons, will be insufficient to cover the demand of France and her possessions and protectorates on the north coast of Africa, so the French will still have to import heavily. They may receive sugar from Czecho-Slovakia, from Poland, and from Belgium or Holland, but the quantities furnished by those countries will not suffice to make up the difficiency. The French colonies in Africa and the West Indies will supply another 100,000 tons, while the balance will have to come from Cuba.

Spain and Italy.—It is supposed that Spain and Italy will produce enough sugar for their very restricted consumption. Italy produced in 1919-20 170,466 tons and expects a similar quantity now. Importation is not easy, as a consequence of the low value of the lire. At any rate, there is no question of any export either from Spain or from Italy and very little probability of imports of any moment.

Jugo-Slavia.—In Jugo-Slavia the 1919-20 crop produced 35,000 tons of sugar, while the consumption amounted to 60,000 tons. Sugar was imported from Czecho-Slovakia to fill the gap. This year the Government has established a sugar monopoly there which takes over the production of the four existing factories, and purchases the sugar to be imported. For next year the estimates are 50,000 tons of sugar to be produced, and 30,000 tons to be imported for making up the calculated full consumption of 80,000 tons.

Denmark.—In Denmark, where the sowings have undergone some reduction as compared with last year, 160,000 tons of sugar are expected against 152,852 tons in 1919-20. The consumption is estimated at 120,000 tons white, equivalent to 133,000 tons of refined sugar, which shows that the country will produce sufficiently for its own wants and be, moreover, able to export a small surplus.

Sweden.—The beet sowings in Sweden have been extended from 34,000 hectares to 42,000, and in consequence of this extension the probable production is estimated at 195,000 tons, while in 1919-20 it amounted to 163,000 tons. In that country too, the production will exceed consumption, and it is not at all impossible that part of the surplus may find an outlet into adjacent countries.

Other countries.—We have not received any figures regarding the crops of Switzerland, Bulgaria, and Rumania, but we are prone to believe that the quantities to be produced in these countries will not be large. Switzerland used to produce about 5000 tons per annum, while Rumania has not planted more than 6900 hectares of land with beets for this crop, so that it will certainly need some imported sugar.

Taking together the data from the countries of which we have obtained trustworthy reports, we arrive at the following table of probable production in tons of raw. We add for comparison the real 1919-20 production of the same countries, from which one can see that an extra 1,146,442 tons or 47·3 per cent. more can be expected than in the disastrous year of 1919-20. The yield will not be sufficient to allow an unlimited use of sugar, but the supply will be rendered more plentiful and the urgent demand for sugar from other parts of the world may be considered over, at least so far as the Continent of Europe is concerned.

Country	Actual Production of 1919-20	Estimates of 1920-21
Germany	717,875	1,100,000
Czecho-Slovakia	475,877	738,000
Hungary	36,000	45,000
Austria	5,132	4,500
Poland	53,761	210,000
Netherlands	238,692	320,000
Belgium	146,918	225,000
France	183,330	300,000
Italy	170,466	175,000
Spain	81,655	100,000
Denmark	152,852	160,000
Sweden	163,000	195,000
Total	2,425,558	3,572,000

Russia, Ukrainia, Switzerland, Bulgaria, and Rumania: doubtful.

Agricultural Notes.

On extending the milling season.—It is beginning to be recognised that it is impossible to deal with the whole sugar crop in a large mill when the canes are all at their optimum of sugar production. To keep the mill at work for its hundred days, or whatever period is fixed upon, some of the canes will have to be still rather immature, while others will have passed their best. A good deal has been done and is being done by a suitable selection of early and late varieties, but there are limits to this practice. Planting in a succession of months has been found usually to be of less advantage, for when the climate has a well-marked sequence of heat and cold, moisture and dryness, there is a distinct tendency for it to impress itself on the canes, so that they ripen more or less at the same time whenever they have been planted. But the matter is of sufficient importance in the full exploitation of the canes of a plantation for a broad view to be taken and every means tested, in different localities, that may lengthen the milling season.

In some places much use is made of ratooning: for, with their well-developed root system, ratoons mature appreciably earlier than plant canes. In other places, where ripening is not confined to only one period of the year, the length of time in the ground may vary without special harm, and we hear of main and subsidiary crops, short and long ratoons and similar terms. Then a good deal may be done by varying the amount and character of the manure applied. Thus, specially large quantities of nitrogenous manures, whether slow acting like oil cake or rapid as in soluble artificials, prolong the period of growth, so that in some cases the canes with their greater growth do not have time to mature in the proper growing season. On the other hand, by limiting the quantity of such manure, the canes, with a shorter growing period, ripen off quite early. In both cases there are disadvantages: with little manure the quick crop is a short one, and with much the canes lock up the land beyond the normal and may interfere with suitable rotation of crops. These facts will be familiar to all who have had charge of experimental manurial plots, and are here mentioned in order that the matter may be considered by intelligent planters who may succeed in getting something useful out of them. Series of rough analyses made fortnightly as reaping time approaches should be carefully studied, and perchance a lengthening of the season when the canes are at their best may result from such observations.

A crop very similar to ratoons, but without its special disadvantages and dangers, may be obtained in another way, namely, by splitting up the old stools and replanting the pieces. This method involves a certain amount of labour, but if properly organized it has been found to need much less than was supposed. In any case, the old stools have to be got rid of and are sometimes rather difficult to dispose of. Experiments conducted by the writer have shown that, if the old stools from an acre of canes are cut into two or three pieces and these are planted, they will suffice to plant up five acres of land. With their rapid and vigorous growth, they may be put in further apart than planted sets, and therefore than ratoons; there is a marked absence of gaps in the field, and the incidence of diseases which usually attack ratoons are avoided because of the change of soil. They, like ratoons, ripen appreciably earlier than plant canes, and the crop ripens in a very uniform manner. The experiment is therefore worth trying in other localities. Reference may here be made to another experiment, although this does not claim to produce early maturing canes. Its chief use is for such places as have an insufficient time for preparing the land, or where there are difficulties in the incidence of the rains or the openings of irrigation channels. The sets were planted in a nursery, so close together that they almost touched one another in all directions. When lifted and planted in the prepared holes or trenches, it was found that a remarkably even stand of healthy canes was invariably obtained, while the act of lifting did not appreciably retard the maturing of the crop at the usual time. One great advantage is claimed for this method, which entails very little extra work, and that is that all diseased sets are rigorously and easily excluded and none but healthy plants are found in the fields. One acre of nursery was found to be capable of planting up 13 acres of plantation.

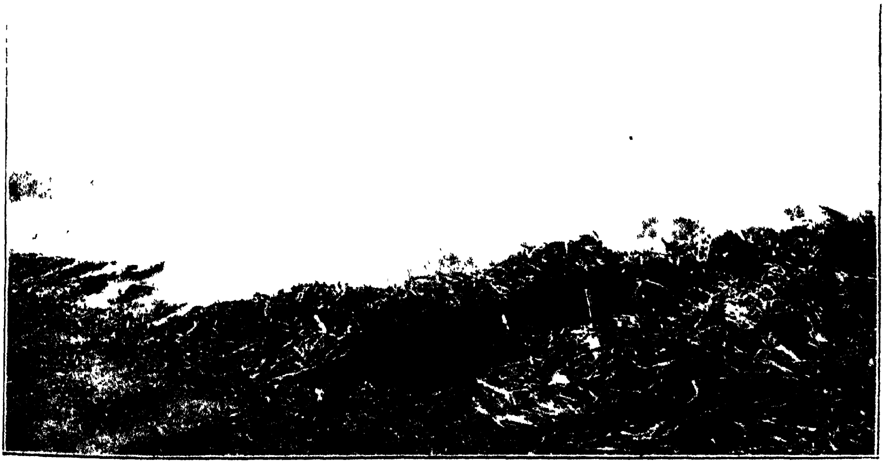
New facts regarding the burning of cane trash.—In spite of the repeated warnings as to the danger involved as to soil fertility by burning the dead cane leaves after harvest right across the ground, the practice is very widely spread. It is not intended in this note to discuss the pros and cons, the advantages and disadvantages, the necessity or otherwise of burning, but merely to present certain facts recently come across concerning the burning of the vegetable matter in soil intended for coffee planting. From a consideration of these facts some idea may be formed as to what is involved in sugar plantations.

When a planter opens up new forest land in the hills for coffee, the first thing to be done is to get rid of the great mass of trees as speedily as possible, and some form of burning is usually necessary. There is a historic observation made by one planter many years ago who, before burning off a piece of forest on his estate, drove a long, thick iron bar into the ground so that it just sank out of sight: after burning, this stake, much to his surprise, was seen to be full six inches above the surface, roughly indicating the layer of soil which had been destroyed. We had occasion in a recent note of this series to remark on the value of jungle top-soil, and it is easy to imagine the effect of this simple experiment on the views of the coffee planters in the neighbourhood.

It is recorded that some of the oldest coffee estates in Mysore, probably a century old by now, are still successfully cultivated: there is no apparent falling off in their yields and they have never been subject to the disastrous borer attacks which have taken such heavy toll from many other localities, and it has been shrewdly surmised that this superiority in these old estates over more recently founded ones may lie in the fact that they were put down at a time when the forest was never burned when clearing the land, the trees being allowed to decay after killing or felling. In modern practice, when quick returns are claimed by shareholders, there is not time to adopt this leisurely practice, but every care is taken to restrict the action of the fire on the soil as much as possible. After felling, the branches and light scrub are piled into as few heaps as possible, for it is recognized that nothing is more disastrous to the fertility of the soil than a "running fire."

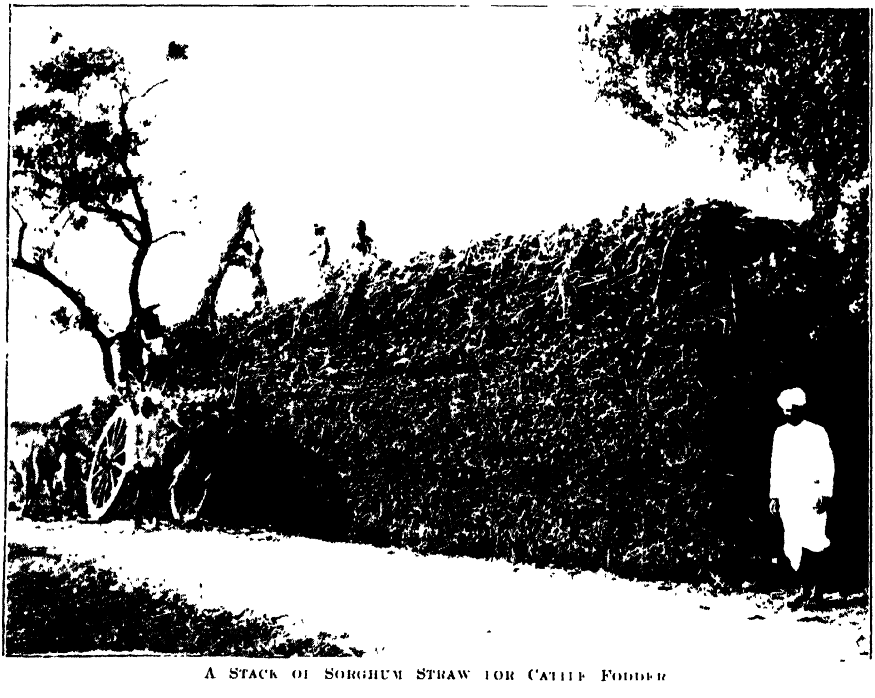
Lastly, in estimating the value of coffee estates, it is customary with some planters to pay less attention to the actual conditions of the crops and general upkeep than to the previous history of the land before the estate was opened. There are three classes of forest to be considered: (1) Old forest never known to have been interfered with by man and bearing no signs of it; this is the most valuable class. (2) Forest formerly burned and the existing forest secondary: the value of this is much less, but will depend upon the length of time since the original forest was removed: it is estimated that it would take from 100 to 150 years for its ancient state of fertility to be fully recovered, according to locality and rainfall. (3) Forest more or less recently planted or allowed to grow on pasture land: this is as inferior to the second class as that is to the first.

LOADING CANE AT BUNDABERG



"RUNNING FIRE" BURNING THE CANE TRASH

A Moderate Field of Sorghum in Madras



A Stack of Sorghum Straw for Cattle Fodder

Burning the trash regularly on sugar land definitely prevents the accumulation of humus which it is seen is so greatly valued on coffee estates. And it becomes a question whether there can be any advantages obtained by regularly burning which will counterbalance the loss of this opportunity of increasing the vegetable matter in the soil. We have taken the liberty of reproducing two excellent photographs from a recent bulletin by H. T. EASTERBY.[1] The first of these shows the amount of vegetable debris lying on the soil after cutting the cane, and the second shows the "running fire" burning the trash.

C. A. B.

Millets for Fodder on Sugar Estates.

By C. A. BARBER, C.I.E., Sc.D., F.L.S.

I.

In a recent "Agricultural Note" attention was drawn to the importance of improving fodder supplies on sugar estates, and it was suggested that lessons might be learnt from the indigenous dry farming practised in the East, where with scanty supplies of water and on comparatively poor soil large quantities of food and fodder were habitually grown in the struggle for existence. Millets are the main crop in such dry regions and it is estimated that one third of the population of the world is interested in their cultivation. As an accessory fodder and food crop some form of millet is probably far and away the most economical and productive. But these crops are little known in sugar growing countries, and it is with the idea of placing the facts dispassionately before planters that the present study has been prepared. After a few remarks on millets in general, it is proposed to deal with one of them as a type and then add notes on the others as occasion may arise.

The millets occupy a very distinct place in tropical agriculture; they are the indigenous dry-land cereals of the tropics, and especially of the Old World. Maize generally takes their place in the New World, but this is essentially a sub-tropical staple; wheat, barley and oats are temperate cereals, and when they penetrate into the tropics they are generally grown on the outskirts, as in Northern India, or in elevated tracts where the climate is not tropical, and then only in the "cold" weather: rice is of course tropical, but it is a wet land crop and the whole methods of its cultivation are entirely special and different from those in crops that are rain-fed.

As is the case with all these crops, millets are occasionally irrigated, especially in tracts with a well developed agricultural practice, during the dry periods of the year, and very much greater yields are then obtained. But they are essentially rain-fed: they are, all of them, markedly drought resistant, and, maturing quickly, can be grown without irrigation in very dry tracts, where the rains come at only one time of the year: they mature in from three to five months and are thus quite common in regions with less than 20 in. annual rainfall or what are termed semi-arid countries.

Just as wheat penetrates into the tropics and rice into the temperate regions, so the millets sometimes stray outside their tropical limits, and this is the case especially with the Italian or Hungarian millet (*Setaria italica*) which may be found from Europe to the Cape Colony, and may be seen in English botanical gardens in the summer, but this species is more adaptable than the rest.

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[1] H. T. EASTERBY "The Cultivation of Sugar Cane in Queensland." Bulletin No. 3, General Series. Bureau of Sugar Experiment Stations, Queensland, 1920.

They all of them have small grains, the giant among them, which will form the subject of this article, *Andropogon Sorghum*, having grains little over one eighth of an inch in diameter; they may be generally distinguished by their rounded grains and are best known in this country as fowl food or bird seed. In the tropics they form the staple food of the people in the interior, where water is not available for rice growing; they are equally useful for fodder and for cattle and for human consumption; but, as they are only grown for local use, they do not enter largely into export trade.

They form the heart of the dry-land cultivation in Africa, and in Asia are specially developed in India, China, and Japan: there are 40,000,000 acres under millets in India, and the outturn in Japan is given as 35,000,000 bushels every year. They occur where the most primitive and yet intensive dry-farming in the world exists, and their cultivation is therefore associated with old-world simple implements, and they are grown in rotation or as mixtures with pulses, cotton, tobacco and a number of non-irrigated tropical crops.

Sorghum has been selected for detailed study because it is the most important millet: its agricultural needs are greater than some of the smaller forms, but it can be grown like the rest under unpropitious conditions, while with careful treatment it is capable of a comparatively enormous production as a cereal. It has thus a very wide range of usefulness.

It is chiefly grown for food and fodder, but in America, where it has been introduced from the East, there are forms which are specially adapted for producing sugar syrup and others for making brooms (hence the names "sweet Sorghum" and "broom corn"). This millet can produce great yields under favourable conditions: it is credited with giving "ten times the outturn of most cereals." The grain is an excellent food for man, the stalks are carefully stacked for fodder, and can also be used for fuel if thus required. In the New World it is chiefly grown for fodder, but for grain in the Old World, although it is always used there as a fodder too. The grain is used for cattle and horses, for fattening pigs and for poultry. Sugar is exuded from lesions in the stems and leaves and, as stated, special forms have been developed which produce excellent syrups from the juicy stems.

There is considerable doubt as to the place of origin of Sorghum: it has many wild relatives and is widely scattered in the indigenous cultivation of Africa, India and China. Most probably it was first used in tropical Africa, was thence passed through Egypt to India, and from India to China and Japan; its introduction into the New World is comparatively recent, possibly through the slaves from Africa, as these are known to have brought many of their home plants with them. In India alone have we accurate information as to its distribution: the average acreage for the past seven years was 21,166,166. Bombay has 7,000,000, Madras 5,000,000, the Central Provinces 4,000,000: thus the Peninsula has two-thirds of the whole, and this emphasizes its tropical nature. In North India its substitutes are maize, wheat and another millet, *Pennisetum typhoideum*.

Botanically, it is a tufted grass, but as grown the stalks are few: this is of advantage as ensuring even ripening, a matter of great importance at the harvest. It is the largest cereal. Because of the mode of growth, usually stems with single heads, there is little separation between the branching and flowering stages which characterize the growth of all grasses. The heads of panicles vary greatly in size and form. When grown for grain, the close round or oval head is preferred, but the open panicle when it is purely a fodder crop. The "irungu cholams" of South India appear to be ideal as a fodder crop, and seed should be obtainable of all varieties by application to the Department of Agriculture in Madras. There are sometimes curious forms, such as the one in which the flower stalk bends down so that the head hangs downwards: it is difficult to trace the origin of this, but it is of advantage as a protection against birds, as they can obtain no foothold. There are two kinds of flowers, sessile which are fertile, and stalked which are sterile. The flowers are proterogynous, that is, the female organs ripen first; this necessitates cross pollination and the plant is wind-fertilized, a fact which is of some importance as regards the crop. If, for instance, heavy rains occur at the time of flowering, the yield will be very seriously affected. This is a point to be borne in mind with all the millets, and it influences some of the others to a greater extent than Sorghum. The grains are large for a millet, as already noted. In Bombay there is a variety which has double grains. The glumes, or chaffy outer scales of the grain, vary greatly in colour, so that we have black, brown, red, yellow, white and spotted grains, by which differences many of the varieties are most easily recognized. The leaves are broad, like those of maize, two-ranked, wavy edged, with hyaline ciliated ligule, the little membranous protrusion at the junction of leaf-sheath and leaf. The roots are surface feeding, varying in depth according to soil and moisture, i.e., as to whether it is grown as a wet or dry crop. Besides the ordinary soil roots, it possesses a series of aërial roots, which spring from the lower joints above ground; these roots are strong and bend outwards and downwards into the soil where they branch, thus holding the tall plant erect after the manner of tent ropes. A true classification is at present impossible, because of the mixed nature of the fields where crossing has proceeded for ages unchecked. The colour of the glumes is a useful character, dry, pithy and juicy, sweet stalks, habit and especially shape of the head, agricultural requirements as to soil and water, length of growing period, drought resistance and so on, all are of assistance in determining the different kinds. It is interesting in this connexion to connect the kinds of Sorghum grown with the local races of people: when a native migrates, he takes a few of his own seeds with him, for he finds that the kinds met with do not suit his palate or digestion, and the appearance of a strange form of Sorghum in the fields will often lead to the discovery that such a migration has taken place.

As to environment, all will depend on the character of the rains. Sorghum often experiences conditions which would destroy ordinary cereals such as maize. There must be free drainage, for it will not bear any standing water. Here maize has the advantage, for the writer has seen the crop reaped from boats, where the plants at crop time were under six feet of water. Sorghum has a remarkable power, which is not shared by maize, of remaining quiescent during periods of drought and immediately recovering with a shower of rain. Experiments made in the Great Central Plains region of the United States have shown that Sorghum and bullrush millet require less rain to produce a ton of hay than any other cereal tried. The cultivation of Sorghum is often a triumph of man over nature, both in North Africa and in the east, by taking advantage of casual showers which would be of no use to any other crop but a millet. The Tamil proverb runs: "if you have little to eat, sow cholam."

The preparation of the land and cultivation are simplicity itself. Sorghum can be grown on very poor land but of course the yield will be affected in such a large plant: it grows best in deep red loam where a height of 12-16 ft. is not uncommon, and black soil also seems to suit it very well. Such manure as is available is heaped in the dry weather and the land is cleared of deep rooting grasses: on the first showers the land is ploughed repeatedly by the simple Indian ploughs, and two or three weedings are needed and, if planted in rows, harrowings to keep the surface mulch of soil. There may be all stages from the most primitive to the most advanced dry-farming.

Sowing varies greatly according to conditions, from two to three seeds in a shallow hole, broadcasting against a basket, or drilling. The rate varies according to whether it is grown for grain or green fodder, as well as the kind of soil, etc. Four to ten times as much seed is sown for green fodder, as then the stems are as close as in a field of wheat: when grown for grain the plants are thinned when 6-8 ins. high so that they are about a foot apart each way: 10-15 lb. per acre should be sufficient for a crop intended for grain and straw, 40-100 lb. when it is intended for green fodder. Sorghum is often sown as a mixed crop with legumes, and the most various mixtures are in vogue in India. To give an example: five crops are sometimes sown together: cucumbers will ripen in six weeks, cow peas in three months, Sorghum in four months, red grass (pigeon pea or *Cajanus indicus*) in seven months and when the latter is reaped, the whole field will be covered by it and no trace left that any other crop has been grown. The time of sowing depends on the incidence of the rains, not heavy rains but occasional showers: this is extremely important in dry tracts, and is forcibly expressed by another Tamil proverb, "if the time of sowing is missed cholam will not grow if it is sown on a dunghill."

The best method of reaping is to cut the field and lay the plants spread out on the ground for four days, then raise them in cocks for a month to allow the immature grains to harden; then thresh and heap the straw into great ricks. This straw will keep for the best part of a year and provides good fodder for cattle. If raised for green fodder it may be cut as required, the best food value being obtained when the flowers are beginning to set seed: or the whole may be cut and stacked in a rick, after a little wilting, the stalks being laid with the heads inwards.

The yield depends of course on conditions, and there may be from 100 to 500 to 1500 lb. of grain: if grown for fodder anything up to 25 tons may be harvested. It is a common practice to ratoon the crop for a time, as the stalks left will send out many shoots. But this requires some care and should not be attempted by novices. The young foliage if poorly grown develops a deadly poison, but this does not occur if there are rains or the soil is moist and the growth free. Such ratooned Sorghum forms excellent grazing for the cattle.

The crop has its own diseases and pests which are far too numerous even to catalogue in detail. All insects, all birds, many beasts together with fungi and even small parasitic flowering plants. In growing crops, aphides, mites, ear moths, stem and shoot borers, smuts, rusts, protozoa, moulds: also seeds germinating on the plant in wet weather, low lying places and alkaline spots should be guarded against: as stored grain the usual grain pests will also be met with. There is no space to speak of the value of the grain as food, but it may be mentioned that both grain and flour keep well because of the comparatively little water and oil that they contain. Bread cannot be made from it as it will not form loaves, but as cakes and porridge it is excellent, once the somewhat peculiar flavour is mastered.

Steps are being taken to organize a company in the South Island of New Zealand for the purpose of establishing a beet sugar factory in the vicinity of Christchurch. It is hoped to induce the local farmers to raise at least 80,000 tons of roots or 2,000 to 3,000 acres. New Zealand requires 75,000 tons of sugar annually as the per capita consumption is 130 lbs. The present retail price is 6½d. as compared with 2d. per lb. before the war.

Fifty Years Ago.

From the "Sugar Cane," November, 1870.

In an article entitled "Cane Culture in Australia," by an anonymous writer, reference is made to the method of clarification employing "clay batter, or gypsum, or whiting batter" in conjunction with milk-of-lime. Stiff adhesive clay, containing little sand and organic matter, was dried in the sun, crushed, and passed through a 10 to 14 mesh sieve. Previous to use, this powder was mixed with water to the consistency of cream, and four to eight gallons of it added with the determined quantity of milk-of-lime in the case of a clarifier of 500 gallons. Gypsum or whiting batter prepared in the same way was also recommended.

It was stated that this addition was found to render subsiding more rapid and more certain, giving a denser precipitate containing less sugar. Juices of so inferior a quality as to be quite intractable by the ordinary process using milk-of-lime alone could often (it was said) be satisfactorily treated in this way.

Mr. ALFRED FRYER contributed an article in this issue under the heading of "The Use of Lime," in which he pointed out the importance of the careful regulation of the amount of this reagent in clarification, concluding with the statement that "consideration of all the foregoing will show the importance of keeping cane juice during the process of manufacture on the concretor in a neutral state. . . . Each clarifier of juice should be carefully tested with litmus paper, not only on its surface, but also as it is running off. . . . Carelessness in this respect may lead to grievous disappointment, while care will be amply repaid." Figures were given showing that the amount of caustic lime per 1000 imperial gallons of juice used in the West Indies varied between 2 and 12. Analyses of concretor sugar from different sources had been made, and from these the author concluded that inferior juice yielded a product containing 0·2 per cent of lime; an average juice, 0·14; and a good juice, 0·07 per cent.

An article discussed in detail the method of liquoring involving the use of suction, for the application of which a special apparatus had been protected.[1] As would be obvious, this improvement had resulted in a considerable saving in time and labour, compared with the old system of draining the liquor through the moulds simply by gravity.

Other articles were entitled "Practical Observations on Cane Manure," by Dr. T. L. PHIPSON; "The Utilization of Sewage"; "Cane Culture in the Island of Réunion"; "Arrangement of Clarifiers, etc., for a Sugar House"; "Sugar from Palm Trees"; and "The Beetroot Sugar Industry in France," which latter dealt with the state of the fields and factories. During the investment of Paris, necessitating temporarily the suspension from publication of our contemporary, the *Journal des Fabricants*, the damage on the whole at the time of writing was not considerable; but the editor of *La Sucrerie Indigène* (now unfortunately discontinued) added that "with the tendency of the enemy to extend their ravages, and with their vandalism, which shows itself in sacking and burning all that resists them, ... we are unfortunately threatened with further calamities."

No patents were abstracted in this issue of our predecessor, nor were the statistics recorded of more than passing interest.

[1] French Patent, 84,731 of Jugl and Kodl.

On the Settling of Precipitates in General and of Cane Juice Precipitates in Particular.

By NOËL DEERR.

A number of years ago the writer was asked to state the rate at which the precipitate, formed on defecating cane juice, settled. To this question he could give no definite answer, and, reference to textbooks not helping, he was led to investigate the matter. The investigation led to a general study of the behaviour of the settling of suspensions and the results of a series of experiments are given in the present communication. Some of the results here given are not now for the first time brought forward, and reference may be made to HAZEN[1] for a mathematical analysis dealing specially with the sedimentation of sewage, to KOHN[2] and especially to COE and CLEVENGER.[3] The work of the last named deals with the sedimentation of mining sludges and by a coincidence the writer attacked the problem in a way very similiar to that used by them, even independently coining the same phrases.

The general equation expressing the fall of a particle under the influence of gravity through a resistant medium is given by Stokes' Law: $v = \frac{2}{9} \frac{(d_1 - d_2) r^2 g}{\mu}$ where v is the velocity of fall, d_1 and d_2 are the densities of the particle and the resistant medium respectively, r is the radius of the particle, μ is a constant dependent on the viscosity of the resistant medium, and g is the acceleration due to gravity. The immediate problem before the writer was, however, the rate of fall of an assemblage of particles, with d_1, d_2, r and μ considered as constant, the variables being the concentration of the suspensions, and in the case of cane juices the treatment which it had received before settling obtained. The problem was first of all studied with a number of different materials such as barium sulphate, calcium phosphate, alumina hydroxide, and of these the last mentioned was selected for a detailed series of experiments, after it had been ascertained that all these materials settled in the same general way.

In developing a technique which would give results that were to be applicable to actual problems of design, a settling tank was conceived as being built up of a plurality of vertical tubes acting independently of each other, and therefore the experiments were conducted in tubes of great height in proportion to diameter. Before doing so however experiments were made to determine what, if any, influence height and diameter had on the rate of settling. It was found that as between the heights 50 mm. and 1500 mm., and the diameters 10 mm. and 100 mm., all the materials examined behaved in the same way, and it was therefore concluded that it is justifiable to step from a tube of 10 mm. diameter to a tank of any height and of any diameter.

The technique followed in the experiments was to prepare a stock suspension of alumina hydrate from which other suspensions were made. The stock suspension was found to contain 0·369 grm. alumina as Al_2O_3 per 100 c.c. From this stock definite quantities were taken and made up to definite volume. Concentrations stronger than that of the stock were made by allowing a portion of the stock to settle, decanting the supernatant water and adding a further portion of the stock. The tube used in the experiment was 1450 mm. high and 19·3 mm. in diameter.

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[1] *Trans. Am. Soc. Civ. Eng.*, 1904, **53**, 46.

[2] *Chemiker Zeitung*, 1907, **31**, 1287.

[3] *Trans. Am. Inst Min. Eng.*, 1916, **55**, 336.

It held 425 c.c. of material. In conducting an experiment the suspension in the desired concentration was transferred to a 500 c.c. flask and mixed by gentle rotation in a vertical plane after which it was poured into the tube up to the zero graduation. It only then remained to observe and note the level of the falling material at definite time intervals.

In making a preliminary series of experiments, it was observed that three distinct types of settling occurred dependent on the concentration of the suspension. With more dilute suspensions up to (with alumina) 0·08 grm. per 100 c.c., the particles fall independently of each other, and the time required for a column to settle is that required for a particle to fall from the top to the bottom of the tube. In these cases the quantity of material settled in unit time is always proportional to the concentration of the suspension. With increasing concentration, however, the particles in their downward path interfere with each other and the rate of settling is controlled by the concentration of the suspension. The limits of this phase of settling are roughly confined by the concentrations (with alumina) of 0·08 to 1·0 grm. per 100 c.c. With higher concentrations the particles seem to be in close contact, and the action is one rather of the shrinkage of a column under its own weight than that of a freely falling assemblage of particles.

The intermediate stage of settling is that which occurs in the defecation of cane juices, and presenting some interesting phenomena was studied in detail.

If such a suspension containing from 0·1 to 0·5 grm. of alumina hydroxide per 100 c.c. be poured into a tall tube and allowed to settle for a period of not less than three minutes it will be found to have resolved itself into five zones. The uppermost zone, *1* (Fig. 1) is quite clear; next in order is zone *2* characterized by the presence of stragglers. These stragglers are readily seen to be particles of not less than average size, which have in someway detached themselves from the main body of the suspension. Eventually, the stragglers catch up with and join the main body of the falling suspension. The zone marked *4* contains at an early stage of settling the main body of the precipitate. In this zone can be recognised a main downward current of particles and a main upward current, the limits of the motion of which are confined between the contingent surfaces of zones *3* and *5* described below. In addition to the vertical streaming movement of the particles in zone *4*, the individual particles are seen to possess an oscillatory or gyratory motion, and a particle in the upward stream would occasionally detach itself therefrom and might eventually join the downward stream, and *vice-versa*. During the whole of this phase of the settling, the concentration of the particles in zone *4* seems to remain constant per unit volume of this zone.

Zone *5* is that zone which is being gradually built up by those particles which have completed their journey to the bottom of the tube or rather to the top of the column represented by zone *5*. The process of building up this zone can be easily observed and it will be seen that individual particles of the downward stream on approaching zone *5* detach themselves from zone *4* and fall vertically a short distance immediately losing any gyratory motion that they possessed. This last and lowest zone while being built up is simultaneously shrinking, but for all of the first stage of settling it suffers a net increase in height.

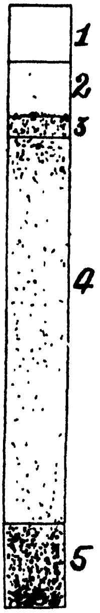

FIG. 1.

Zone *3* is only about 10 mm. in depth. The particles here have no gyratory motion and they seem to stay unchanged throughout the whole process of settling, in a sense seeming to float on the top of the particles in zone *4*. When the particles in the upward stream in zone *4* reach this zone they turn through an angle of 180° and pass continuously into the downward stream. Occasionally the upward velocity of a particle will be enough to carry it right through zone *3* when it becomes a straggler.

During the process of settling, zone *4* is constantly changing its position in the tube and is becoming shortened in its length from both ends. Eventually its depth is reduced to zero at which point zones *3* and *5* meet. The former very rapidly passes into the latter and at this point the first stage of settling is ended, and the system now consists solely of zone *5*. Before this point is reached, the outline of the upper limit of zone *3* coincident with the lower level of the clear supernatant liquid is irregular in outline, but at the moment when the system is reduced to zone *5* the level becomes sharp and flat and can easily be read to 0·5 mm. This position which can be timed to within 10 seconds is called by Coe and Clevenger the *critical position* and this term will be adopted here. That phase of settling which obtains before the critical position is reached will be called the "phase of free fall" and the state which obtains after the critical position will be termed the "phase of restricted fall."

Dealing now solely with the phase of free fall, it was observed that on pouring the suspension into the tube there elapsed a small time, less than two mins., over which no settling occurred. It does not seem unreasonable to suggest that for this period the suspension was in the colloid state. It appeared to be homogeneous and the gradual appearance of particles of definite size could be observed. After settling had once begun, it proceeded at a uniform rate until very close to the critical position; the period that elapsed between an observed retardation in the rate of fall and the appearance of the critical position being about 30 seconds. The data of an actual experiment, one of many of the same nature, are given below.

Alumina hydroxide. 0·217 grm. per 100 c.c. Height of Column 1450 mm. Time in minutes from beginning of experiment given under t. Depth of column of supernatant liquid given under d in millimeters.

t	d	t	d	t	d
4	180	20	970	60	1208
6	280	25	1082	65	1215
8	380	30	1120	70	1221
10	480	35	1145	75	1226
12	580	40	1162	80	1231
14	680	45	1179	85	1235
16	770	50	1191	90	1239
18	870	55	1200	100	1246

The critical position occurred in 21 mins. 40 secs. at at a depth of 1030 mm.

After having observed the phenomenon of a critical position, some experiments were made to determine in what degree, if any, this was affected by the original height of the column. It was found that if h be the height of the column and d be the height of the column of settled material at the critical position, the ratio d/h was constant, as was also the ratio $(h-d)/t$, where t is the time to the critical position. The details of an experiment are given below:—

h mm.	d mm.	t secs.	d/h	$(h-d)/t$
1450	205	1145	0·141	0·108
965	139	758	0·144	0·109
545	77	437	0·142	0·107

A series of experiments was then made with varying concentrations of suspended matter and the results are given in tabular form below. In all the experiments the original height of the column was 1450 mm. The concentrations (c) varied from 0·0868 to 0·4340 grms. of alumina hydroxide as Al_2O_3 per 100 c.c. Under d is given the height in mm. of the column of settled matter at the critical position; h is the depth of the column of supernatant liquid and is equal to 1450—d. The time to the critical position is given under t in seconds. The ratio h/t then gives the rate of settling in millimeters per second. The ratio ch/t gives the quantity of material in grms. that have fallen 1 mm. in 1 sec., and may be called the rate of mass settling. The ratio d/c gives numbers proportional to the mean concentration of the column of settled material at the critical position.

Inspection of the tabulated results shows: —

1. That as the concentration of the suspension increases the rate of settling decreases.

c	d	h	t	h/t	ch/t	d/c
0·0868	110	1340	955	1·40	0·122	12·7
0·1085	135	1315	1045	1·26	0·137	12·8
0·1302	175	1275	1190	1·07	0·139	13·4
0·1519	208	1242	1260	0·98	0·148	13·7
0·1736	245	1205	1340	0·90	0·156	14·1
0·1953	276	1174	1415	0·83	0·162	14·1
0·2170	317	1133	1480	0·76	0·165	14·6
0·2604	412	1028	1605	0·64	0·167	15·8
0·3038	520	930	1680	0·55	0·167	17·0
0·3472	570	880	1800	0·48	0·165	18·0
0·3906	692	758	1800	0·42	0·165	18·3
0·4340	766	684	1800	0·38	0·166	18·9

2. The rate of mass settling regularly increases until a concentration of about 0·2 grm. per 100 c.c. is reached; after this concentration it remains constant up to at least one of 0·45 grm. per 100 c.c.

3. The mean concentration at the critical position increases as the concentration of the suspension increases.

It should be remarked that as the concentration increases, the location of the critical position becomes less and less exact, the change becoming more and more gradual.

The statement made under 2 above refers solely to the mass settled at the critical position. Reflection will show that eventually the more concentrated suspensions will settle more material than those less concentrated, so that as t increases the ratio ch/t will increase with increase in c.

After the critical position has been reached, the rate of settling decreases with each increment of time. Two determinations are given below which were obtained in this way. The height of the column was determined at the critical position: let this be h_o. After such an interval that settling has become slow let the height be h_n and let h_t be the height at time intervals t. On plotting $h_t - h_n$ against t a curve suggesting a logarithmic function was found, and actually up to 90 minutes from the critical position it was found that the relation $\frac{1}{t} \log \frac{h_o - h_n}{h_t - h_n} =$ constant, fairly well represented the course of settling. Values of $h_t - h_n$ and of the constant are tabulated below. The original concentrations in the experiments here recorded were 0·1736 and 0·3472 grms. per 100 c.c.

$t = o,\ h_o - h_n = 136.$			$t = o,\ h_o - h^n = 328.$		
t	$h_t - h_n$	$\frac{1}{t}\log\frac{h_o - h_n}{h_t - h_n} \times 100$	t	$h_t - h_n$	$\frac{1}{t}\log\frac{h_o - h_n}{h_t - h_n} \times 100$
5	111	0·176	5	275	0·152
10	94	0·161	10	221	0·171
15	77	0·165	15	195	0·150
20	65	0·160	20	165	0·149
25	56	0·154	25	137	0·158
30	48	0·150	30	117	0·149
35	41	0·156	35	99	0·148
40	35	0·147	40	83	0·149
45	30	0·145	45	68	0·152
50	25	0·147	50	54	0·157
55	21	0·148	55	43	0·160
60	17	0·150	60	34	0·164
65	13	0·152	65	26	0·175
70	10	0·162	70	19	0·176
80	4	0·191	80	8	0·202
90	0	—	90	0	—

At time $t = 90$ the actual heights of the columns, h_n, were 194 mm. and 217 mm. These quantities are deducted from all observed readings to obtain $h_t - h_n$.

After having made the experiments described above and determined the general principles under which settling occurs, I wished to apply the results to to cane juice defecation. Through the kindness of Mr. E. F. Atkins, I was able to obtain from the Soledad plantation in Cuba a supply of raw juice preserved with 1 per cent. of formaldehyde. This material, which was of 15·6 Brix and on arrival 65° purity, was used in the experiments described below. It behaved in every way as a typical juice, and though the results may not be exactly applicable to all juices, their bearing on defecation problems is believed to be generally justified.

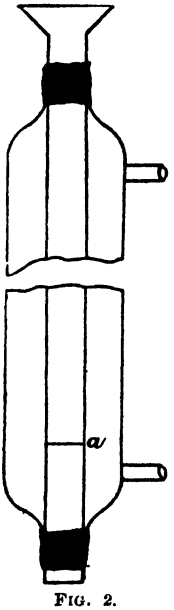

Fig. 2.

The apparatus used in studying cane juice defecation was developed out of a Liebig condenser, and is indicated in Fig. 2. It only differs from the condenser in that the inner tube is blinded off near the bottom, as shown at *a*. A constant temperature of 212°F. was obtained by passing a current of steam at atmospheric pressure through the outer jacket. A millimeter scale pasted on the outside of the jacket completed the apparatus. The overall length of the jacket was 1100 mm., giving room for a column of material 1000 mm. high completely enveloped in steam. The internal diameter of the inner tube was 1·25 mm. or 0·5 in.

The technique of making an experiment was as follows:—To a definite quantity of juice the desired quantity of lime was added, after which the material was placed in a flask fitted with a reflux condenser and gently boiled for one minute. In the meantime steam had been circulating in the settling apparatus, raising all parts to 212°F. Finally, the material was poured into the tube up to zero graduation, after which nothing more remained to do than to watch its behaviour and to time the rate of fall. It was found that if experiments were made without the preliminary boiling, whereby all the air was expelled, the results were irregular and illusory.

Preliminary experiments showed that, under these conditions (which were designed to simulate what happens in the factory), cane juices settled precisely as had been observed when dealing with suspensions of alumina of intermediate concentration, i.e., there is a short initial period of disturbance, followed by a phase of free fall until the critical position occurs, when the phase of restricted fall obtains. All of the phenomena described for these conditions were distinctly visible.

Anyone who has operated a cane sugar house cannot but have observed that variation in the juice and in the quantity of lime added affects the rate of settling and also the volume occupied by the mud. Accordingly, experiments were made with this special apparatus to examine these points. The particular juice examined possessed an acidity of 1·75 c.c. normal per 100 c.c., referred to phenolphthalein as indicator. To 100 c.c. of juice there was then added as defecant 0·5, 0·75, 1·0, 1·25, 1·5, 1·75, and 2·0 c.c. of a normal suspension of lime. The settling experiment was then made as described above, the results being tabulated below, the figures recorded giving the height in millimeters of the clear supernatant column of juice at the time in minutes indicated under *t*. The initial height of the column was in all cases 1000 mm.

Regarded from the point of view of the factory operator, the juices with 0·5 and 0·75 c.c. of lime suspension would have been recognized as distinctly underlimed; that with 1 c.c. would have been considered doubtful, depending on the caprice of the operator. The writer would have accepted the two next in order as typical of a satisfactory defecation, that is to say, the juice was bright and clear and "cut" well. While fairly bright that juice with only 1 c.c. of lime was distinctly inferior to the two next above, those with less lime being decidedly "muddy." The two preparations with the larger quantity of lime were bright and of that peculiar golden yellow colour characteristic of overlimed juices.

TIME MINS.	c.c. NORMAL LIME PER 100 c.c. OF JUICE.						
	2·00	1·75	1·50	1·25	1·00	0·75	0·50
2	80	70	100	120	160	320	570
4	190	160	240	250	450	700	700
6	320	300	400	580	760	870*	820*
8	450	440	580	782*	840*	888	870
10	590	580	755*	838	856	896	885
12	742*	700*	817	856	867	900	895
14	787	777	841	862	874	902	904
16	802	820	849	866	879	902	910
18	812	833	856	868	883	902	914
20	820	844	860	870	885	902	914
22	825	850	863	872	887	—	—
24	830	855	866	874	888	—	—
26	834	858	869	876	889	—	—
28	839	861	871	878	890	—	—
30	843	863	873	880	891	—	—

The asterisk denotes the "critical position."

The apparatus used allowed of an oversight over the whole process of settling, and it was observed that the two preparations with least lime formed a precipitate in large flocks irregularly distributed throughout the juice, and that this behaviour occurred in less degree with that preparation next in order. In all the others the precipitate appeared to be regularly distributed and the settling to take place in a normal manner.

Inspection of the tabulated results shows a distinct connexion between the amount of lime used and both the rate of settling and of the ultimate volume occupied by the mud, the former decreasing and the latter increasing as the quantity of lime increases.

Taking the quantity of lime represented by 1·5 c.c. normal suspension per 100 c.c. of juice (0·042 grm. per 100 c.c.) as representative of good practice, the question propounded at the beginning of this communication can be answered:—

A cane juice properly treated settles during the stage of free fall at a uniform rate of 7 cms. per min. The critical phase occurs at 0·75h where h is the height of the settling tank and the ultimate volume of the mud is about 15 per cent. of the volume of the juice.

Some other observations may be recorded. Between the densities of 15° and 20° Brix no difference as would affect design was observed in the rate of settling. This can be deduced from Stokes' Law since changing d_2 from 1·05 to 1·08 will not very much affect the value of $d_1 - d_2$ when d_1 has a value of about 2. The addition of kieselguhr or of phosphoric acid with subsequent neutralization with additional lime retarded the rate of settling. That this would result follows from the mass settling experiments made with alumina hydroxide.

Finally, an experiment was made to determine the effect of initial height of column on the rate of settling after the critical position had been reached.

The same suspension of alumina hydroxide was filled into the tube to heights 1450 mm. and 665 mm. The critical position occurred with the settled column at heights of 353 mm. and 190 mm. At 1 min. intervals therefrom the observed heights were as recorded below :—

Time Mins.	Height of Settled Column.	
0	353	190
1	334	175
2	320	165
3	308	158
4	299	152
5	291	147
6	284	143
7	278	140
8	273	137
9	268	134
10	264	132
11	260	130
12	257	128
13	254	127
14	252	126

During this stage of settling the originally taller column had settled much faster, an observation which would tend towards giving a rather higher value per unit of volume to tall tanks than to shorter ones.

Unfortunately, pressure of other matters has prevented any further work on these lines.

During 1919 a certain confectionery firm having a number of shops in London and the Provinces made a profit on their trading account amounting to more than three times their capital. In this year they paid more in excess profits duty than their capital. During 1920 equally good results are being obtained. This is the case of a firm making only moderate profits in pre-war days.

The output of the coming Trinidad sugar crop is likely to be between 25 and 30 per cent. greater than for last season and may prove a record one. The high prices which have prevailed for sugar during the last few years have caused a great deal more land than ever to be put under sugar cane. During this same period there has been considerable increase in efficiency in sugar manufacture and a considerable extension of factory facilities. The sugar estates and factories controlled in the United Kingdom have generally spent considerable amounts for improvements and extensions.

Cane Mill Efficiencies.

By T. WISHART.

The daily or other reports for most sugar factories contain figures showing "sucrose extracted per cent. sucrose in cane, per cent. fibre in cane and in bagasse, maceration water per cent. cane, boiling-house efficiency," and much other information, but from the figures given only the most vague idea can be formed as to the actual performance of the milling plant. Even the man responsible cannot say if to-day's work is really better than yesterday's, and still less can he say in what respect or how much his plant is better or worse than that in the next factory, particularly if there is a difference in size or number of units employed, or in the composition of the cane.

To remedy this state of affairs various formulae have been constructed from time to time and are useful according to their scope, but are not exhaustive enough, and do not allow of the work being examined in detail, nor of being compared with either general or particular results elsewhere. Any system of comparison should enable judgments to be made under the following heads :—

Material handled per unit weight of machinery.
Material handled per unit dimensions of rolls.
,, ,, ,, horse-power.
Quality of crushing, and of extraction.

As it is hoped that the scheme now proposed may be widely adopted, it is advisable to state exactly the meaning of terms and units used.

One inch = 25·39 mm. One lb. = 0·4535 kilogram.
One foot = 0·3048 metre. One Horse-power = 33,000 ft. lbs or 746 Watts.

D = Diameter of mill roll in inches, and any difference in dimensions of crusher rolls to be neglected.
N = Total number of rolls in mill plant, including crusher rolls, and allowance for shredders or cutting knives where these are used (see Note A at end).
H = Horse-power per foot length of roll to drive the complete outfit, excluding cane and bagasse carrier drives.
G = Weight in lbs. of complete mill plant per foot length of roll, excluding cane and bagasse carriers.
Fc = Per cent. fibre in cane.
Fb = ,, ,, bagasse.
M = Non-fibre in final bagasse as per cent. on cane.
W = Total maceration water applied per cent. cane.
Sn = Sucrose per cent. normal juice.
Sr = ,, ,, in residual juice of final bagasse.
C = Lbs. cane crushed per hour per foot length of roll.
F = ,, fibre produced ,, ,, ,, ,,

All comparisons and formulae refer to *one foot* length of roll.

Mill speeds and hydraulic loads are not dealt with as such, but are included in H; they, together with mill settings and method of applying the maceration water, are at the discretion of the mill superintendent, and while they are to a large extent the determining factors, the present state of knowledge does not permit them to be formulated.

Weight of machinery:—This varies greatly, but excluding cane and bagasse carriers, $G = D^2 \times N \times 10{\cdot}5$ approx. .. .. .. (1)
for a good modern plant without hydraulic attachments. If hydraulics are included, $G = D^2 \times N \times 12{\cdot}0$ approx. .. .. (2)

Capacity of plant:—Under ordinary conditions with cane of 12 per cent. fibre,
$C = D^2 \times \sqrt{N} \times 4{\cdot}16$ approx. .. (3)
also $F = D^2 \times \sqrt{N} \times 0{\cdot}5$ approx... .. . (4)

Horse-power:—This varies with D and N, also with the hydraulic load and mill speed. Under ordinary conditions,
$H = D \times N \times 0{\cdot}14$ approx. .. .. .. (5)

The values inserted in the above and succeeding formulae are illustrative only, and are intended to show the order of magnitude of the figures to be expected from any one plant. Using (2) (3) (4) and (5), and assuming them to belong to one plant,

$$\frac{C}{G} = \frac{0{\cdot}336}{\sqrt{N}}, \text{ and } C = \frac{0{\cdot}336\,G}{\sqrt{N}} \quad \ldots \ldots \ldots \ldots \quad (6)$$

$$\frac{F}{G} = \frac{0{\cdot}04}{\sqrt{N}}, \text{ and } F = \frac{0{\cdot}04\,G}{\sqrt{N}} \quad \ldots \quad (7)$$

$$\frac{C}{H} = \frac{29{\cdot}16D}{\sqrt{N}}, \text{ and } C = \frac{29{\cdot}16DH}{\sqrt{N}} \quad \ldots \quad (8)$$

$$\frac{F}{H} = \frac{3{\cdot}5\,D}{\sqrt{N}}, \text{ and } F = \frac{3{\cdot}5\,DH}{\sqrt{N}} \quad \ldots \ldots \ldots \quad (9)$$

$$\frac{H}{G} = \frac{0{\cdot}0155}{D}, \text{ and } H = \frac{0{\cdot}0155G}{D} \quad \ldots \ldots \ldots \ldots \quad (10)$$

The equations (6) to (10) are given to show that results stated as "lbs. fibre per foot of roll" or "lbs. fibre per horse-power hour" are valueless for comparisons except when they refer to plants which are nominally identical.

A milling plant is primarily a machine for extracting juice from the sugar cane, but it is also a machine for producing bagasse, as dry and as free from sugar as may be possible, and its efficiency for the latter purpose shows equally its efficiency for the former in practice.

A mill which working "dry" produced bagasse containing nothing besides dry fibre would have an efficiency of 100 per cent. on both counts, but if it required 1000 per cent. maceration water to do the work, its efficiency as a bagasse maker would remain 100 per cent., while its efficiency as a juice extractor would be problematical.

It is practically impossible to state mill efficiencies as percentages, and "figures of merit" are suggested. Such figures should be mutually comparable, independent of size or extent of the milling plant.

All particulars used for returns should be found in daily reports or in engineer's log, or should be deduced easily from these. The "figures of merit" should be calculated as under; the example given for illustration is from an 11-roll plant:—

$D = 34$ in.; $N = 11$; $C = 15{,}400$ lbs.; Fibre per cent. cane $= 11{\cdot}6$; Fibre per cent. bagasse $= 51{\cdot}0$; Sucrose in normal juice $= 17{\cdot}3$ per cent.; Sucrose in bagasse $= 4{\cdot}2$ per cent.; Maceration water 30 per cent. on cane; $H = 49$; $G = 152{,}600$ lbs.

CAPACITY AND DIMENSIONS OF PLANT.

Figures on dimensions:—

$$\text{Figure Cane Capacity} = \frac{C}{D^2 \times \sqrt{N}}$$

$$\text{Example ,, ,, ,,} = \frac{15{,}400}{34^2 \times \sqrt{11}} = 4{\cdot}006$$

$$\text{Figure Fibre Capacity} = \text{Figure Cane Capacity} \times \frac{Fc}{100}$$

$$\text{Example ,, ,, ,,} = 4{\cdot}006 \times \frac{11{\cdot}6}{100} = 0{\cdot}4647$$

$$\text{Figure Dryness} \;..\; = \frac{Fb}{100}$$

$$\text{Example ,, ,,} \;..\; = \frac{51}{100} = 0{\cdot}51$$

The fibre is already 51 per cent of the bagasse, but to show the quality of the work, or in other words to impose a penalty for inferior crushing, the last two "figures" are multiplied together, thus:—

$$\text{Figure Crushing} = \text{Figure Fibre Capacity} \times \text{Figure Dryness.}$$

$$\text{Example ,, ,,} = 0{\cdot}4647 \times 0{\cdot}51 = 0{\cdot}237$$

This figure would express the efficiency of the plant as "dry crusher."

When maceration water is used, extra juice is of course gained and for comparisons the quantity of the latter may be expressed as:

$$\text{Figure gain} = \frac{\text{Fig. fibre cap. } (100 - Fb.)}{Fb} \times \frac{Sn - Sr}{Sn}.$$

$$\text{Example—Figure gain} = \frac{0{\cdot}4647 \times 49}{51} \times \frac{17{\cdot}3 - \dfrac{4{\cdot}2 \times 100}{49}}{17{\cdot}3} = 0{\cdot}225.$$

If it is assumed for the moment that the mill could get this gain without the addition of water, it is clear that the bagasse juice itself would have served as the medium in extracting the gain, also that the mill would have aided to the extent of using the bagasse juice undiluted. But maceration water is added, and the proportion of juice in the mixture expresses the extent to which the mill "aids" in the extraction of the gain.

$$\text{Figure aid} = \frac{(100 - Fb)\,\dfrac{Fc}{Fb}}{(100 - Fb)\,\dfrac{Fc}{Fb} + W} \text{ or } \frac{M}{M + W}.$$

$$\text{Example ,, ,,} = \frac{11{\cdot}145}{11{\cdot}145 + 30} = 0{\cdot}27.$$

In arriving at a figure to express the "attainment" of the mill the obvious method is to add the detail "figures" together, excluding "figure cane capacity" which is no real measure of the mill's performance. This would be the "show" method, and in the example

Figure fibre capacity = 0·465 .. .. .. quantity
,, ,, dryness = 0·510 .. . .. quality
Figure gain = 0·225 .. . .. quantity
,, aid = 0·270 .. .. .. quality

Figure attainment = 1·470

As indicated, some of the figures relate to quantity and the others to quality of work, and if the corresponding fractions are multiplied together, the results are of practical use as,

Figure crushing $=$ Fibre capacity $\times$ dryness.
Example ,, ,, $= 0{\cdot}465 \times 0{\cdot}51 = 0{\cdot}237$.
Figure extraction $=$ Gain $\times$ aid.
Example ,, ,, $= 0{\cdot}225 \times 0{\cdot}270 = 0{\cdot}061$.

As these are now qualified quantities their sum represents the actual product of the mill.

Figure product $=$ Figure crushing $+$ Figure extraction.
Example ,, ,, $= 0{\cdot}237 + 0{\cdot}061 = 0{\cdot}298$.

All the results are mere fractions, but it must be remembered that they relate to one "mill element" to be compared with the element of any other mill.

The example is from $D = 34$ in., $N = 11$,

and $D^2 \times \sqrt{N} = 1156 \times 3{\cdot}31 = 3826{\cdot}3$ elements, the "figures" being for one of these elements.

The figures found so far refer only to dimensions and extent of the plant and are all that would be required in ordinary circumstances. Occasionally figures relating to capacities and horse-power may be required, but as indicated earlier capacities cannot be referred directly to horse-power when comparisons are to be made, but only in conjunction with *D* and *N*. .. See equation (9). Thus:—

Figure power $= \dfrac{H}{D \times N}$
Example ,, ,, $= \dfrac{49}{34 \times 11} = 0{\cdot}131$.

CAPACITY AND POWER.

Figure fibre cap./power $= \dfrac{\text{Figure fibre capacity}}{\text{Figure power}}$
Example ,, ,, ,, $= \dfrac{0{\cdot}4647}{0{\cdot}131} = 3{\cdot}547$.

The actual fibre per horse-power is $\dfrac{1786}{49} = 36{\cdot}5$ lbs., but this figure is useless for comparisons with mills of other dimensions or extent. It will be obvious that the remaining figures for Cane Capacity, Gain, Crushing, Extraction, and Product, if each is divided by Figure Power, will give corresponding figures relative to Horse-Power.

CAPACITY AND WEIGHT OF PLANT.

As already remarked, figures relative to weight of machinery are generally of little importance, and very often the actual weight of plant is unknown. Assuming, however, that the weight is known accurately, the corresponding figures of capacity/weight are obtained as follows:—

Figure weight of plant $= \dfrac{G}{D^2 \times N}$.
Example ,, ,, ,, $= \dfrac{152600}{34^2 \times 11} = 12{\cdot}0$.
Figure fibre cap./weight $= \dfrac{\text{figure fibre capacity}}{\text{figure weight}}$.
Example ,, ,, ,, $= \dfrac{12}{0{\cdot}4647} = 0{\cdot}0387$.

As in the case of capacity/power figures, the remaining figures relative to weight are obtained by dividing each of the merit figures by figure weight.

The relation between horse-power and weight may occasionally be of interest in showing whether or not the plant uses more power for its weight than the prevailing practice would indicate:—

$$\text{Figure power/weight} = \frac{\text{figure power}}{\text{figure weight}}.$$

$$\text{Example} \quad ,, \qquad ,, \quad = \frac{12{\cdot}0}{0{\cdot}131} = 0{\cdot}0109.$$

The actual horse-power divided by actual weight in the example is: $\frac{49}{152600}$ $= 0{\cdot}00032$ horse-power per lb. weight, but this figure is useless for comparisons. Other figures on the same lines are possible, but the most important have been shown above.

If for a given plant the "figures" were calculated regularly, each alteration would show its effect in the appropriate figure, and in the overhead figure, and so facilitate the reaching of the best conditions for the work. Frequent publication of such figures, if accompanied by particulars of size, number of rolls, cane preparation machines, speeds, settings, hydraulic loads, method of applying maceration water, besides the usual statements as to extraction, fibre and sucrose in cane and in bagasse, etc., would be of real service to all concerned in the industry, besides which they would be worth reading. Any reports so far published are so lacking in detail that no idea of the performance can be gained, except that the writer of the report considered it noteworthy.

NOTE A.—*Allowance for shredder.*—This is an uncertain amount, as few figures on the subject have been published, but a fair allowance would seem to be equal to the addition of three rolls to the plant. Thus, an 11-roll plant with a shredder would be equivalent to a total of 14 rolls, and would be calculated as such. Similarly, each set of revolving cane knives on the carrier would count as one roll added to the plant. In any case, where these appliances are used the fact should be stated.

The Question of the Distance between Cane Rows.

A Brief History of its Investigation.

By ARTHUR H. ROSENFELD.

(*Continued from page 565.*)

LATER EXPERIMENTS AT THE TUCUMAN SUGAR EXPERIMENT STATION.

In 1916, another series of experiments was initiated with the P.O.J. 213 cane, a variety of much less distinct type of growth to the P.O.J. 36, the latter being much more erect and having less tendency to fall late in the season in case of rainy weather. The plan of this experiment was identical to that just described with the P.O.J. 36. A resumé of the preparation and cultivation of this plat for the three years of the experiment (one of plant and one each of first and second year stubble) follows:—

Having selected a large plat of ground of apparently uniform composition throughout, a good preparation was given and the P.O.J. 213 cane planted the middle of August, 1916. Early in September all sub-plats were irrigated and the soil scratched with a hand cultivator. At the end of October another irrigation was given and the dirt knocked off the cane with spades. Three other irrigations were given—one each in November, April and May. The small Planet Jr. cultivator was sent down the middles on 26th November, 11th and 21st December, 23rd January, 3rd February and 5th March. The rows were weeded with spades the middle of December and the first week in January. The lay-by was given at the end of January, 1917. Crop was made on 29th August, 1917.

The cultivation of the first year stubble was begun early in September, 1917, after burning off the trash, the middles being broken out, the rows off-barred, and the stubbles shaved and dug by machinery. The small Planet Jr. cultivator was ent down the middles on 8th and 20th October, 14th and 28th November, 26th December and 9th February, the lay-by being given early in December. The crop of the first year stubble was made on July 8th, 1918.

As second year stubble, tho trash was burnt off and an irrigation given on 9th September. The middles were then broken out, the rows off-barred, and the stubbles shaved and dug, as already described, for previous years. The middle of September the middles were harrowed down level and the Planet Jr. cultivator was sent through on 18th October, 9th November, 1st December, and 2nd and 21st January. The rows were weeded with spades on 9th November, and the cane was laid-by with the six-disc straddling cultivator on 20th December, crop taking place on September 11th, 1919. Table XII gives the average results for the three years in condensed form :—

TABLE XII.—AVERAGE RESULTS FROM THREE CROPS OF P.O.J. 213 CANE.

Distance between Rows. Feet.	Average Weight of Stalks. Grms.	Met. Tons Cane per Hectare.
Three	467	47·67
Four	498	48·58
Five	495	46·13
Six	509	44·24
Seven	517	43·14
Eight	543	45·00

Once again we see that there is relatively little difference between the average yields of cane per hectare in the distinct sub-plats, the three lots with the smaller distances between the rows having given slightly better yields than the three with wider middles. The average size of the stalk has also increased again in direct proportion to the distance between the rows. CROSS calls attention to the fact that this increase in weight of stalk is due to greater thickness of the canes rather than to increased height. The conclusions reached from this experiment, therefore, simply confirm those from the previous one—that the smallest possible distance should be given between the rows which is compatible with efficient cultivation with modern cultivation machinery. CROSS gives the opinion that, for the very abundantly suckering P.O.J. 213, this distance should probably be six feet.

EXPERIMENTS WITH BAMBOO TYPE OF CANE.

These experiments were begun in 1916, with two types of bamboo canes, one the now famous Kavangire (Uba) and the other a cane which was imported into Louisiana from Japan by STUBBS and from Louisiana to the Tucumán Experiment Station in 1910—called Zwinga. The two varieties are very similar in type and the experiments were made in adjacent lots on the Experiment Station, both receiving identical cultivation.

The sub-lots were laid out along the same lines indicated in previous experiments after the land was well prepared for planting, the planting being done on August 12th, 1919. On 23rd August and 9th September irrigations were given all rows, followed by a scratching of the soil to preserve a dust mulch. On 11th November dirt was knocked off the cane with spades and irrigations were given on

20th November, 19th and 30th January, 5th April and 2nd May, each irrigation being followed by a cultivation with the small Planet Jr. machine, in order to maintain the essential dust mulch and, in turn, the humidity. As in all other experiments, these cultivations could not be given to the three-foot middles, where all cultivations had to be made with spades. Cultivations were also given on 23rd December and 9th March. The cane was laid by with the six-disc straddling cultivator the middle of February, 1917, in all lots except the first two (those with middles at three and four feet respectively) in which the lay-by was given with spades. The crop of the plant cane was made at the end of July.

As first year stubble, after burning off the trash, the middles were broken out in the middle of September, 1917, and the cane off-barred. The dirt around the stools was then stirred a bit with spades, and the middles were cultivated with the Planet Jr. cultivator on the 10th and 26th October. On 10th November dirt was thrown to the rows with the six-disc straddling cultivator and the middles once more cultivated with the little Planet Jr. machine. Irrigations were again given on 24th November and 9th December, the Planet Jr. cultivator being sent down the middles shortly afterwards in each case. Later cultivations with this little machine were given on 26th December and 8th February, the first year stubble being harvested on 12th August.

As second year stubble, the trash was burned off as usual and the cane irrigated early in September, 1918, the middles then being broken out, the rows off-barred and the stubbles dug and shaved as in previous years. The Planet Jr. cultivator was sent down the middles on 16th October, 1st, 21st and 30th December, and the 21st January, the shares being so arranged in the first two cultivations as to return to the rows the dirt taken away in the off-barring. The cane was laid by with the six-disc straddling cultivator on 28th December, 1919, and was harvested on June 18, 1919. Table XIII gives the average results in condensed form of the three crops (one of plant and two of stubble) for each of the varieties.

TABLE XIII.—AVERAGE RESULTS FOR THREE YEARS WITH KAVANGIRE AND ZWINGA CANES.

Width of Middles Feet	Average Weight Stalk, Grms.	Metric Tons Cane per Hectare	Kgs. Sugar per Hectare
	I. Kavangire.		
3	336	60·00	3071
4	370	62·67	3318
5 1/3	397	60·50	3466
8 1/3	445	57·28	3607
	II. Zwinga.		
3	270	58·33	2744
4	295	57·75	2686
5 1/3	298	54·63	2536
6 2/3	321	59·05	2847
8 1/3	334	57·56	3197

Here we find once more that the variation in yield of cane per hectare between the distinct widths of middles with each variety is only about five tons of cane per hectare, which might well be considered within the limits of the experimental error.

The average weight of the stalks has again increased in direct proportion to the width of the middles in the cases of both varieties.

Summed up, then, this series of experiments gives us no reason for changing the conviction already formed as to width of middles.

THE SUB-STATION EXPERIMENTS.

After the first series of experiments with the Creole cane in the Experiment Station in Tucumân, it was decided to start a large-scale experiment on the Monte Belle sub-station of the Tucumân Sugar Company, using both the native striped and purple canes. A piece of land which was practically virgin soil and measuring just twenty acres was selected for the experiment and given good preparation. The plat was divided into eight subplats of two and a half acres each (one hectare approximately), four plats being devoted to the native striped and four to the native purple cane, the rows being laid out in each series at five, six, seven and eight feet. The seed cane was very carefully selected and the plantation was made the middle of July, 1912. At the end of November the dirt was knocked off the rows (*desembo-quillada*) and early in December the middles were cultivated with reversible disc harrows. The middle of December the weeds were cut with machetes, and the reversible disc harrows again sent down the middles. The 23rd December tooth harrows were sent down the middles, this process being repeated at the end of January. Early in February another cultivation was given with reversible disc harrows and the middle of that month the rows were weeded with spades. Crop was made the latter half of August, 1913, with the results shown in Table XIV.

TABLE XIV.—RESULTS FROM CROP OF PLANT CANE AT MONTE BELLO.

Subplat No.	Variety.	Width of Middles, ft.	Average Weight of Stalks, gms.	Metric tons of Cane per hectare.	Average of Two Varieties.	Chemical Analyses of Juices.				Manufacturing Value.	Kgs of Sugar per hectare	Average of Two Varieties.
						Brix.	Sucrose	Glucose	Purity.			
1	Striped	5	1420	83·11	82·07	15·3	12·5	0·4	81·6	10·2	5934	5745
2	Purple	5	1240	81·02		15·6	12·3	0·4	78·8	9·7	5501	
3	Striped	6	1430	73·82	68·13	16·3	13·3	0·5	81·5	10·8	5581	4864
4	Purple	6	1220	62·44		14·8	11·9	0·6	80·4	9·6	4196	
5	Striped	7	1470	69·73	65·73	13·2	10·1	0·8	76·5	7·7	3758	4656
6	Purple	7	1300	61·73		16·7	14·5	0·4	86·8	12·6	5445	
7	Striped	8	1590	61·45	58·07	15·9	13·3	0·4	83·6	11·1	4775	5049
8	Purple	8	1230	54·68		17·7	15·6	0·2	88·1	13·7	5569	

In yield of cane per hectare the decrease is very regular as the width of the rows is increased, the cane at 5 ft. giving exactly 24 tons of cane more per hectare than that at 8 ft. The analyses of the juices were so very irregular that no direct effect can be attributed to the distance of planting, the best analysis having been given by the purple cane at 8 ft., the second best by the purple cane at 7 ft., and the third best by the striped cane at 8 ft. Undoubtedly, the best average purities correspond to the rows which were wider apart.

In 1913 the cane planters sold their cane at an average price of about $7 gold per ton; therefore, it is simple to calculate the financial advantage of the 5 ft. rows over those spaced at a greater distance. These figures will be found in Table XV.

TABLE XV.—FINANCIAL ADVANTAGE OF THE FIVE-FOOT ROWS.

Subplats.	Distance between Rows, ft	Average No. Tons of Cane per hectare.	Value of Cane per hectare, at $7 00 per ton. $	Value of going over Widest Middles. $
1 and 2	5	82·07	574·49	168·00
3 ,, 4	6	68·13	476·91	70·42
5 ,, 6	7	65·73	460·11	53·62
7 ,, 8	8	58·07	406·49	—

The cane from the 5 ft. rows, then, was worth almost $100·00 more per hectare than that from the 6 ft. rows, and almost $115·00 more than that from the 7 ft.

rows. This, however, was only as plant cane, hence we must now study the stubble results.

1914 was the year of Tucumân's record crop to date, and was a year in which no frosts fell. The cane in these experiments was not harvested for that crop, but was left for that of 1915, without further cultivation or attention. Notwithstanding the fact that this cane was 23 months old when harvested, the results were very inferior to those of the plant cane when harvested early in July, 1915, as shown in Table XVI.

TABLE XVI.—FINAL RESULTS FROM THE MONTE BELLO EXPERIMENT.

Subplat No.	Variety.	Width of Middles, ft.	Average Weight of Stalks, gms.	Metric tons of Cane per hectare.	Average of Two Varieties.	Chemical Analyses of Juices. Brix	Sucrose.	Glucose.	Purity.	Manufacturing Value.[1]	Kgs. of Sugar per hectare.	Average of Two Varieties.
					I. Stubble Cane Crop, 1915.							
1	Striped	5	740	40·18	37·48	14·0	10·7	0·8	76·4	8·17	2298	1941
2	Purple	5	630	34·77		12·4	9·0	1·0	72·6	6·53	1589	
3	Striped	6	630	39·16	38·98	14·6	12·0	0·7	82·2	9·86	2703	2729
4	Purple	6	690	38 80		15·5	12·5	0·6	80·7	10·09	2740	
5	Striped	7	730	38·30	29·42	12·9	9·9	1·2	76·7	7·59	2035	1565
6	Purple	7	540	20·54		12·9	9·8	0·8	76·0	7·45	1071	
7	Striped	8	770	31·68	27·56	14·3	11·2	0·7	78·3	8·77	1945	1678
8	Purple	8	570	23·43		13·9	10·9	0 8	78·4	8·55	1402	
					II. Average of Plant and Stubble.							
1	Striped	5	1080	61·65	59·78	14·7	11·6	0·6	78·9	9·15	3949	3645
2	Purple	5	935	57·90		14·0	10·7	0·7	76·4	8·17	3311	
3	Striped	6	1030	56·49	53·56	15·5	12·7	0·6	81·9	10·40	4112	3742
4	Purple	6	955	50·62		15·2	12·2	0·6	80·3	9·80	3473	
5	Striped	7	1100	54·02	47·58	13·1	10·0	1·0	76·3	7·63	2885	2931
6	Purple	7	920	41·14		14·8	12·2	0 6	82·4	10·05	2894	
7	Striped	8	1180	46·57	42 82	15·1	12·3	0·6	81·5	10·02	3266	3165
8	Purple	8	900	39·06		15·8	13·3	0·5	84·2	11·20	3062	

The decrease in yield of cane per hectare in the stubble cane in direct proportion to the width of the rows is not so regular as it was with the plant, but, nevertheless, it is sufficiently so to be quite striking. The 5 and 6 ft. rows have given about the same quantity of cane per hectare, followed by the 7 and 8 ft. rows respectively. The average weight of the stalks and the juice analyses vary too much amongst themselves to permit of any general conclusions being drawn.

The average of the two crops shows a very steady decrease in yield of cane per hectare as the rows were widened, although the average weight of stalk and the juice analyses do not seem to follow any general rule. This experiment, however, very much confirms the conclusions arrived at in former experiments—i.e., that the middles should be made as narrow as possible consistent with good cultivation with modern machinery, in this case the five-foot rows having given abundant space for the cultivation of the plant cane at least.

AN EXPERIMENT AT SANTA ANA.

In 1917 the author started a large-scale experiment with the P.O.J. 228 cane of Java, with which variety we had as yet made no distance experiments. The

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[1] In this, as in all other tables in this article, the so-called "manufacturing value" is obtained by multiplying the per cent. sucrose by the purity, and this factor is multiplied by 70 per cent. of the weight of cane per hectare, assuming this as the average extraction of the Province, to obtain the probable yield in sugar per hectare.

P.O.J. 228 cane is a very erect grower, with little tendency to fall from the effects of wind and rain, and from the standpoint of cost of cultivation it was thought advisable to investigate the feasibility of planting this variety closer than with the other more spreading varieties such as the P.O.J. 213.

For the experiment a large piece of land of not too good quality was selected, the field covering some 120 acres. It was divided into three plats of some 40 acres each, one having the cane planted at 5 ft., the next at 6 ft. and the third at 6⅞ ft. Details of cultivation, preparation, cultivation, etc., were essentially the same as for the experiments described in the Experiment Station in the corresponding years, the stubble being shaved and dug in the same way as described in those experiments. Unfortunately record-breaking frosts in June, 1918, so destroyed the plant cane that it was not fit for harvesting, hence we have the data of the crops of 1919 and 1920 only, i.e., the first and second year stubble crops. These will be found in Table XVII.

TABLE XVII.

Results with the P.O.J. 228 Cane at Santa Ana.

		Metric Tons of Cane per Hectare.	
Plat.	Width of Middles.	First Year Stubble.	Second Year Stubble.
1	5 ft.	50·32	52·93
2	6 ft.	31·35	32·60
3	6⅞ ft.	32 00	36 80

Once more the 5 ft. rows come out far in excess of the wider ones in yield, there being very little difference between the 6 and 6⅞ ft. middles.

CONCLUSIONS.

Table I shows that in Louisiana there was a fairly regular decrease in yield of cane per hectare as the middles were widened, and Tables II and III confirm these results in that country. In Table IV the 5 ft. rows have given more cane per hectare in Louisiana than the narrower or wider ones, while in Table V we see once more a steady decrease in yield as the middles are widened in Louisiana. In the comparison between 5 ft. and 6 ft. rows in Louisiana, the results of which are given in Table VI, the 6 ft. rows produced 7 tons more cane per hectare than the 6 ft. ones, while in Blouin's Hawaiian experiments, whose results are found in Table VII, the 5 ft. rows lead all the rest by a good margin, followed by the 6 ft., then by the 4 ft. rows and finally by the 8 ft. ones. REYNOSO puts the ideal distance in Cuba at 5½ ft. and BONAME considers 4½ ft. to 5 ft. as best for Guadeloupe. The results from the first series of experiments in Tucumán with the Creole cane, as shown in Table IX, give very little difference between the 3 ft., 4 ft., 5 ft. and 6 ft. rows, the 7 ft. and 8 ft. rows giving appreciably smaller yields per hectare. From these experiments BLOUIN arrives at the conclusion that 5½ ft. is about the best distance between cane rows in Tucumán. The experiments in the Tucumán Sugar Experiment Station with the P.O.J. 36 cane indicate that "approximately the same quantities of cane and sugar per hectare are obtained with rows planted at any distance between 3 ft. and 7 ft.," as shown in Table XI, the results from the experiments with the P.O.J. 213, Kavangire and Zwinga canes, as shown in Tables XII and XIII, frankly confirming this conclusion. In the Monte Bello experiments with Cheribón cane, the results of which are found in Table XVI, the 5 ft. rows have given by far the best results and the decrease in yield of cane as the rows were widened is very regular. Table XVII finally shows that in experiments with the P.O.J. 228 cane in Santa Ana the 5 ft. rows have also come out on top and that only loss of yield results from planting this variety at a greater distance.

The Question of the Distance between Cane Rows.

From this extensive survey of experiments made all over the world, then, we may safely conclude that sugar should be planted in rows as close together as is consistent with proper cultivation with modern machinery, this distance appearing to be about 5 ft. for the thicker types of cane such as Cheribón, Lahaina, B 208, etc., and from 5½ ft. to 6 ft. for the more abundantly suckering types such as the Java canes, the Uba, the Japanese bamboo type, etc.

The Kelham Sugar Beet Factory.

Some further Details of the Scheme.[1]

The Kelham Estate, owned by Home-Grown Sugar, Ltd., comprises 2841 acres, of which 1866 are at present being managed as one farm; 835 acres of this is arable. The Company is preparing to grow for the 1921 campaign the largest possible acreage of sugar beet, and it estimates that at the contract price of £4 per ton of topped beet a net profit of £10 per acre will be secured on this crop alone.

Before the estate was handed over by the British Sugar Beet Growers' Society, Ltd., the latter grew in 1918 sugar beet on two fields, each about 12 acres. The fields were not specially chosen, and being shortly after the Society took over the estate there had been no previous autumn deep ploughing or manuring. The tonnage of washed and topped beet averaged nearly 13 tons per acre, and the analysis of samples showed a sugar content of 17 to 18½ per cent.

The costs of cultivation during 1920, based on actual experience on this estate, are estimated as follows:—

Estimated Costs of Cultivation of Sugar Beet in 1920.

	Per acre.		
	£	s.	d.
Rent	1	10	0
Rates and taxes	0	7	6
Steam cultivation (in the autumn)	1	15	0
Harrowing, twice (in the autumn)	0	4	0
Dung, 10 tons, including carting and spreading (in winter), charge half to beet crop	2	13	10
Ploughing, early winter (deep)..	2	6	0
Artificial manures, including lime, charge two-thirds to beet	5	1	6
Dragging (once)	0	6	0
Harrowing (twice)	0	5	0
Roll (Cambridge)	0	3	0
Harrowing (once)	0	2	6
Roll (plain)	0	2	0
Drilling..	0	3	6
Seed..	1	4	0
Seed harrow	0	2	0
Roll	0	3	0
Horse hoeing (four times)	1	0	0
Chopping out and singling plant	1	17	6
Hand hoeing (twice)..	1	16	0
Horse lifter	0	14	0
Pulling, laying in rows and topping	2	10	0
Loading into carts and carting to hard road	1	5	0
Supervision, per acre..	1	0	0
Depreciation, implements, repairs, etc.	0	15	0
Maintenance	0	6	4
Total cost of one acre in the field in 1920	£27	12	8

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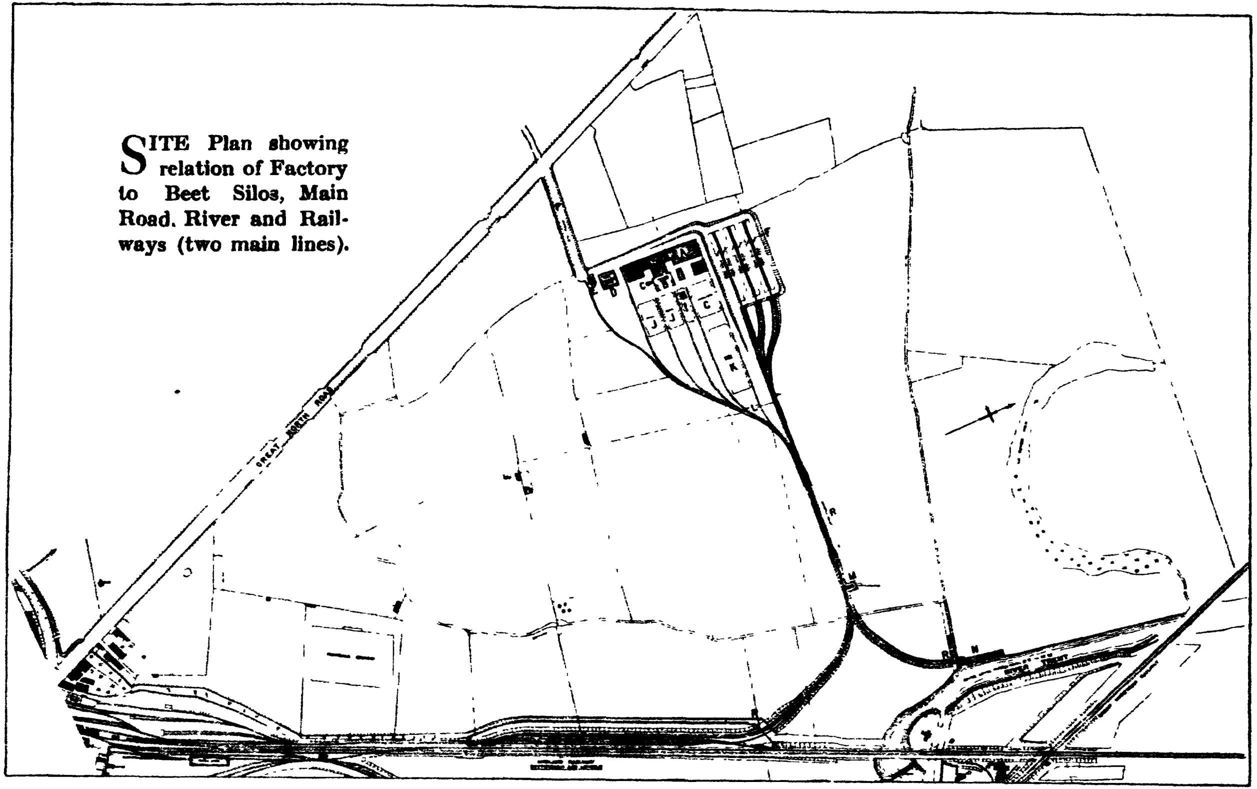
[1] Extracted from *Home Grown Sugar*, Vol. II, 1.



SITE Plan showing relation of Factory to Beet Silos, Main Road, River and Railways (two main lines).

SITE PLAN OF KELHAM SUGAR FACTORY.

(Reprinted from *Home Grown Sugar*, the Journal of the British Sugar Beet Growers' Society, Ltd.)

The Kelham Sugar Beet Factory.

With the above cultivation 10 tons of washed and topped roots to the acre is considered by the estate authorities a very conservative estimate; 16 tons can be obtained, and a satisfactory crop should not be less than 12 tons of sound washed and topped roots.

The capacity of the factory is to be 500 tons per day, though it is designed to work up to 600 tons, or the production of 6000 acres in a campaign. The machinery is being made and lay-out plans prepared by the well known French experts, the Compagnie de Fives-Lille, of Lille and Givors, France.

On the opposite page we reproduce a drawing showing the site plan of the factory and its surroundings. The lettering shows:

A	Main factory.	K	Scum tank.
B	Power house.	L	Railway sidings.
C	Chimney shaft.	M	Rail weighbridge.
D	Machine shop and store.	N	Wharf.
E	Road weighbridge.	O	Lay-by sidings.
F	Beet silos.	P	New entrance road to factory.
G	Lime stone stack.	R	Flood openings to culverts.
J	Coal stacks.		

* * *

The Sugar Industry in Japan 1914-1919.

(British Consular Report.)

The imports and exports of sugar in Japan during the last five years have been as follows:—

	Imports		
Year	From Foreign Countries Piculs	From Formosa Piculs	Exports Piculs
1915	2,077,000	3,486,115	1,165,080
1916	1,601,000	4,248,571	1,461,940
1917	1,316,000	5,574,867	2,209,040
1918	3,725,000	4,535,648	1,908,780
1919	4,548,000	4,560,962	1,095,000

China was throughout the principal importer of Japanese sugar, taking about two-thirds of the export each year. The present consumption is given as about 8,000,000 piculs, as against 5,400,000 before the war.

The Formosan industry is firmly established, though the output of cane is disappointing, due probably to the inadequate return given to the grower by the refiners, who practically control the crop in their districts.

The heavy protection given to the industry in Japan assures the refineries of easy profits and enables them—if necessary—to dump their surplus on the China market. Their exports to that country should show a steady increase.

The import of raw and white sugar from Java shows a big increase. Importation from Java will probably fluctuate, but Japanese refineries will continue to obtain additional supplies from this source as required, as they are in a better position than many of their competitors—including the British refineries established in the East for supplying the China and other Eastern markets—who are dependent on Java for all their raw material and have none of the advantages under which the Japanese companies work.

The Double Polarization Method for the Determination of Sucrose.[1]

By RICHARD F. JACKSON and CLARA L. GILLIS.

(*Continued from page 575*).

NEW METHODS OF PROCEDURE SUGGESTED.

General methods of inversion.—(*a*) Pipette 50 c.c. of the sugar solution into a 100 c.c. flask; add 20 c.c. of water and 10 c.c. of hydrochloric acid of 1·1029 density at 20°/4° C., and immerse in a water bath at 60° C. Agitate the flask continually for about 3 min., and allow it to remain in the bath for a total time of 9 min. Cool quickly.

(*b*) Pipette 70 c.c. of the sugar solution into a 100 c.c. flask; add 10 c.c. of hydrochloric acid of 1·1029 density; and proceed as in (*a*).

(*c*) Pipette 75 c.c. of the solution into a 100 c.c. flask; add 5 c.c. of hydrochloric acid of 1·1918 density, and proceed as in (*a*).

(*d*) Pipette 75 c.c. of the sugar solution; add 10 c.c. of hydrochloric acid of 1·1029 density, and proceed as in (*a*), but allow the solution to remain a total time of 9·5 min.

(e) Pipette 70 or 75 c.c. of the sugar solution into a 100 c.c. flask; heat to 65°C.; add 10 c.c. of hydrochloric acid of 1·1029 density, or 5 c.c. of 1·1918 density. Mix, and allow the liquid to stand for 15 min. (Walker's method of inversion).

(*f*) Pipette 90·91 c.c. of the solution into a 100 c.c. flask[1]; heat to 65° C.; add 5 c.c. of hydrochloric acid of 1·1918 density; mix by rotating the flask; and allow to remain on the laboratory table for 15 min.

(*g*) Pipette 50 c.c. of the sugar solution and add 20 c.c. of water, or pipette 70 c.c. of the sugar solution into a 100 c.c. flask; add 10 c.c. of acid of 1·1029 density; and allow to remain 30·8 hours at 20°, 14·6 at 25°, 7·1 at 30°, 106 min. at 40°, or 29 min. at 50° C. Cool quickly.

(*h*) Pipette 50 c.c. of the sugar solution into a 100 c.c. flask; add 5 c.c. of hydrochloric acid of 1·1918 density, and allow to remain 21·2 hours at 20°, or 10 hours at 25° C.

Method I.

(Applicable to pure sucrose, or to sucrose mixtures in which the impurities are unaffected optically by hydrochloric acid.)

Prepare a normal solution of the sample, or one of suitable fractional normality; make to volume at the temperature at which the observations are to be made; clarify (if necessary) by the addition of *dry* basic lead acetate; and filter.[2] Polarize the solution to obtain the direct reading, and correct (if necessary) to normality. To obtain the invert polarization, follow one of the methods just described, and correct for dilution. The algebraic difference between the two polarizations gives the value *P—P'*; from the following table find the corresponding divisor; subtract the temperature correction using the table given, and divide *P—P'* by corrected divisor, thus obtaining the sucrose per cent.[3]

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[1] By delivering 90·91 c.c. of liquid into a 100 c.c. flask, and making up to volume, it is diluted one-tenth. This is a more convenient, and probably a more accurate, procedure than diluting to one-tenth greater bulk.

[2] If desired at this point the excess of lead may be removed by adding pulverized potassium or sodium oxalate, treating the whole filtrate.

[3] Example:—A solution of sucrose and dextrose, containing 52 grm. in 200 c.c. polarized + 81·25; 70 c.c., inverted, made up to 100 c.c., polarized, and × 10/7 gave 24·86° at 20° C.; P—P' was thus 106·11, the divisor, 133·35, and the sucrose 79·57 per cent.

Table of Divisors for Method 1.

(Sucrose = 100°S.; 13 grms. invert sugar × 2 = — 33·25°S.)

P — P'	50 c.c. × 2	70 c.c. × $\frac{10}{7}$	75 c.c. × $\frac{4}{3}$	90·91 c.c. × $\frac{11}{10}$
133·97	—	—	—	133·97
133·69	—	—	133·69	—
133·60	—	133·60	—	—
133·25	133·25	—	—	—
133	133·25	133·59	133·68	133·95
130	133·23	133·57	133·65	133·92
125	133·20	133·53	133·60	133·86
120	133·16	133·48	133·56	133·80
115	133·13	133·43	133·51	133·75
110	133·09	133·38	133·46	133·69
105	133 06	133·34	133·41	138·63
100	133·03	133·29	133·36	133·57
95	133·00	133·25	133·31	133·51
90	132·97	133·20	133·26	133·45
85	132·93	133·16	133·21	133·39
80	132·90	133·11	133·16	133·33
75	132·86	133·07	133·12	133·27
70	132·83	133·02	133·07	133·21
65	132·80	132·98	133·02	133·15
60	132·77	132·93	132·97	133·09
55	132·73	132·88	132·92	133·03
50	132·70	132·83	132·87	132·97
45	132·66	132·79	132·82	132·91
40	132·63	132·74	132·77	132·85
35	132·60	132·70	132·72	132·79
30	132·57	132·65	132·67	132·73
25	132·54	132·61	132·62	132·67
20	132·51	132·56	132·57	132·61
15	132·47	132·51	132·52	132·55
10	132·44	132·46	132·47	132·49
5	132·40	132·41	132·42	132·43

Temperature Corrections.

(To be subtracted.)

20·0	0·00	21·6	0·85	23·2	1·70	24·8	2·54
20·1	0 05	21·7	0·90	23·3	1·75	24·9	2·60
20·2	0·11	21·8	0·95	23·4	1·80	25·0	2·65
20·3	0·16	21·9	1·01	23·5	1·86	25·1	2·70
20·4	0·21	22·0	1·06	23·6	1·91	25·2	2·76
20·5	0·27	22·1	1·11	23·7	1·96	25·3	2·81
20·6	0·32	22·2	1·17	23·8	2·01	25·4	2·86
20·7	0·37	22·3	1·22	23·9	2·07	25·5	2·92
20·8	0·42	22·4	1·27	24·0	2·12	25·6	2·97
20·9	0·48	22·5	1·33	24·1	2·17	25·7	3·02
21·0	0·53	22·6	1·38	24·2	2·23	25·8	3·07
21·1	0·58	22·7	1·43	24·3	2·28	25·9	3·13
21·2	0·64	22·8	1·48	24·4	2·33	26·0	3·18
21·3	0·69	22·9	1·54	24·5	2·39	28·0	4·24
21·4	0·74	23·0	1·59	24·6	2·44	30·0	5·30
21·5	0·80	23·1	1·64	24·7	2·49	32·0	6·36

Method 2.

(General method, applicable to all products.)

Pipette 50, 70, or 75 c.c. of the sugar solution previously clarified by dry basic lead acetate into two 100 c.c. flasks. For the direct polarization, add to one flask 15 c.c. of an ammonium chloride solution containing 226 grms. per litre, or 3·392 grms. of dry ammonium chloride. Make to volume at the temperature at which the observations are to be made; filter, if necessary, and polarize. For the invert polarization, add to the other flask hydrochloric acid, and invert by one of the other methods described above. After cooling quickly, add from a burette during continual shaking the precisely determined volume of ammonia required to neutralize the acid.[4] Adjust the temperature, make to volume, filter (if necessary), and polarize at a carefully controlled temperature. Correct for dilution, and calculate the result,[5] using the following table.[6]

Table of Divisors for Method 2.

(Sucrose + 3·392 grms. NH_4Cl = 99·43°S.; (13 grms. invert sugar + 3·392 grms. of NH_4Cl) × 2 = — 33·91°S.)

$P - P'$	50 c.c. × 2	75 c.c. × $\frac{10}{7}$	75 c.c. × $\frac{4}{3}$	90·91 c.c. × $\frac{11}{10}$
134·06	—	—	—	134·06
133·78	—	—	133·78	—
133·69	—	133·69	—	—
133·34	133·34	—	—	—
133	133·34	133·68	133·77	134·04
130	133·32	133·66	133·74	134·01
125	133·29	133·62	133·69	133·95
120	133·26	133·57	133·65	133·89
115	133·22	133·52	133·60	133·84
110	133·18	133·47	133·55	133·78
105	133·15	133·43	133·50	133·72
100	133·12	133·38	133·45	133·66
95	133·09	133·34	133·40	133·60
90	133·06	133·29	133·35	133·54
85	133·02	133·25	133·30	133·48
80	132·99	133·20	133·25	133·42
75	132·95	133·16	133·21	133·36
70	132·92	133·11	133·16	133·30
65	132·89	133·07	133·11	133·24
60	132·86	133·02	133·06	133·18
55	132·82	132·97	133·01	133·12
50	132·79	132·92	132·96	133·06
45	132·75	132·88	132·91	133·00
40	132·72	132·83	132·86	132·94
35	132·69	132·79	132·81	132·88
30	132·66	132·74	132·76	132·82
25	132·63	132·70	132·71	132·76
20	132·60	132·65	132·66	132·70
15	132·56	132·60	132·61	132·64
10	132·53	132·55	132·56	132·58
5	132·49	132·50	132·51	132·52

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[4] Previous to commencing the determination, ascertain by at least three concordant titrations in the presence of methyl orange the volume of ammonia solution (5 to 6 N) required to neutralize 10 c.c. of the hydrochloric acid of 1·1029 density used to effect inversion.

[5] Example —26 grms. were dissolved in 300 c.c.; two 75 c.c. portions were used for direct and invert polarizations, and made up to 100 c.c. The direct polarization × 300/75 = 4 proved to be 38·75. The invert polarization × 4 was — 16·22 at 22·4°C. $P - P'$ was thus 54·97. Since the original sample was 1/3 normal, the actual concentration of sucrose was proportional to 1/3 × ($P - P'$) or 18·32. Opposite 18·32 (i.e., between 15 and 20) under the column "75 c.c. taken" we find the divisor to be 132·63. This is diminished by 1·27 for the temperature correction to give 131·36, which divided into 54·97 gives 41·85 per cent. of sucrose as the result.

[6] For correcting the temperature, the table already given is used.

Method 3.

(Applicable in the case of Beet Products.)

After clarifying with the minimum quantity of dry basic lead acetate, filter, and polarize to obtain the direct reading. To obtain the invert reading, pipette 70 c.c. into a 100 c.c. flask, add 10 c.c. of hydrochloric acid of 1·1029 density, and invert by one of the methods described. Cool rapidly. To the cold solution add the precisely determined volume of 5 or 6 *N* ammonia required to neutralize the acid, make to volume at the temperature of observation, and polarize. Correct for dilution, and calculate, using the following table.[7]

$P - P'$	50 c.c. × 2	70 c.c. × $\frac{10}{7}$	75 c.c. × $\frac{4}{3}$	90·91 c.c. × $\frac{11}{10}$
134·63	—	—	—	134·63
134·35	—	—	134·35	—
134·26	—	134·26	—	—
133·91	133·91	—	—	—
133	133·91	134·25	134·34	134·61
130	133·89	134·23	134·31	134·58
125	133·86	134·19	134·26	134·52
120	133·82	134·14	134·22	134·46
115	133·79	134·09	134·17	134·41
110	133·75	134·04	134·12	134·35
105	133·72	134 00	134·07	134·29
100	133·69	133·95	134 02	134·23
95	133 66	133·91	133·97	134·17
90	133·63	133·86	133·92	134·11
85	133·59	133·82	133·37	134·05
80	133·56	133·77	133·82	133·99
75	133·52	133·73	133·78	133·98
70	133 49	133·68	133·73	133 87
65	133·46	133·64	133·68	133·81
60	133·43	133·59	133·63	133·75
55	133·39	133·54	133·58	133·69
50	133·36	133·49	133·53	133·63
45	133·32	133·45	133·48	133·57
40	133·29	133 40	133·43	133·51
35	133·26	133·36	133·38	133·45
30	133·23	133·31	133·33	133·39
25	133 20	133·27	133·28	133·33
20	133·17	133·22	133·23	133·27
15	133·13	133·17	133·18	133·21
10	133·10	133·12	133·13	133·15
5	133·06	133·07	133·08	133·09

Method 4.

(Applicable in the case of Cane Products, that is, in the presence of invert sugar, but in the absence of non-sugars which change their rotation with greater or less acidity.)

As before, clarify with the minimum quantity of dry lead acetate, or (with pure products) by adding alumina cream, and filter. Pipette two 70 or 75 c.c. portions of the filtrate into two 100 c.c. flasks.[8] To one add 2·315 grms. of sodium chloride, or 7·145 c.c. of a saturated solution of sodium chloride, or 10 c.c. of a saturated solution of sodium chloride, or 10 c.c. of a solution containing 231·5 grms. per litre; make to volume at the temperature at which the observations are to be made, and polarize to obtain the direct reading. To the other portion add hydrochloric acid, and invert by one of the methods described; cool, make to volume at the temperature at which the observations are to be made, and polarize. Correct for dilution, and calculate the result using the following table[9]:—

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[7] Applying also the temperature correction table already given.

[8] Alternatively the tenth dilution method, using 90·91 c.c. of the filtrate in 100 c.c., may be used.

Table of Divisors for Method 4.

(Sucrose + 2·315 grm. of NaCl = + 99·38° S.; 13 grms. of invert sugar x 2 = − 33·25° S.)

$P - P'$	50 c.c. × 2	70 c.c. × $\frac{10}{7}$	75 c.c. $\frac{4}{3}$	90·91 c.c. $\frac{11}{10}$
133·35	....	....	....	133·35
133·07	....	....	133·07	....
132·98	....	132·98	....	....
132·63	132·63	....	....	....
133	132·63	132·27	133·06	133·33
130	132·91	132·95	133·03	133·30
125	132·58	132·91	132·98	133·24
120	132·54	132·86	132·94	133·18
115	132·51	132·81	132·89	133·13
110	132 47	132·76	132·84	133·07
105	132·44	132·72	132·79	133·01
100	132·41	132·67	132·74	132·95
95	132·38	132·63	132·69	132·89
90	132·35	132·58	132·64	132·83
85	132·31	132·54	132·59	132·77
80	132·28	132·49	132·54	132·71
75	132·24	132·45	132·50	132·65
70	132·21	132·40	132·45	139·59
65	132·16	132·36	132·40	132·53
60	132·15	132 31	132·34	132·47
55	132·11	132·26	132·30	132·41
50	132·08	132·21	132·25	132·35
45	132·04	132·17	132·20	132·29
40	139·01	132·12	132·15	132·23
35	131·98	132·08	132·10	132·17
30	131·95	132·03	132·05	132·11
25	131·99	131 99	132·00	132·05
20	131·89	131·94	131·96	131·99
15	131·85	131·82	131·90	131·93
10	131·82	131·84	131·85	131·67
5	131·78	131·79	131·80	131·81

Analyses of known mixtures.—In the following table are recorded data obtained in the analyses of sucrose mixtures of known composition. Experiments 2 and 4 were performed as in Method 2, except that sodium chloride and sodium hydroxide were used instead of the corresponding ammonium compounds. For the direct polarization, 3·636 grms. of sodium chloride was added, the solution for invert polarization being neutralized after inversion with sodium hydroxide. The value of the divisor was found from the equations already given.[10]

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[9] Still using the temperature correction tables already given.

[10] See *I.S.J.*, 1920, 573.

Experiment No.	Method	Impurity	P	P'	Temperature	Corrected divisor	Sucrose found	Sucrose taken
		Per cent.	°S	°S	°C		Per cent.	Per cent.
1	IV.—90·91 c.c. for P'; 70 c.c. for P'	0	$99{\cdot}34_0$	$-33{\cdot}58_4$	20.00	132·98	100·00	100.00
2	II.—NaCl, 90·91 c.c. for P; 70 c.c. for P'	0	$98{\cdot}93_7$	$-34{\cdot}44_8$	19·94	133·42	99·77	100.00
3	IV.—90·91 c.c. for P and P'	*a*20·4	$72{\cdot}92_6$	$-35{\cdot}70_8$	20·05	133·07	84·64	84·60
4	II.—NaCl, 70 c.c. for P and P'	*a*20·4	$76{\cdot}59_0$	$-36{\cdot}13_1$	19·83	133·28	84·57	84·60
5	IV.—90·91 c.c. for P and P'	*a*13·9	$29{\cdot}95_0$	$-16{\cdot}32_2$	20·32	132·14	35·02	34·99
6	II.—70 c.c. for P and P'	*a*22·22	$43{\cdot}73_9$	$-24{\cdot}72_8$	20·24	132·99	51·47	51 41
7	II.—70 c.c. for P and P'	*b*30·76	$90{\cdot}71_3$	$-1{\cdot}64_6$	20·11	133·26	69·31	69·21
8	I.—90·91 c c. for P and P'	0	$52{\cdot}25_1$	$-17{\cdot}35_8$	20·14	133·14	52·28	52·28
8	IV.—75 c.c. and N/2 solution for P and P'	*c*40·68	27·60	−15·92	20·10	131·91	32·99	33·08

a Invert sugar. *b* Dextrose. *c* 17·35 per cent. invert sugar, 23·32 per cent. non-sugars from fermented molasses, making a synthetic "black strap" molasses solution.

(Concluded.)

The Clarification of Cane Juice without Chemical Treatment.[1]

By F. W. ZERBAN,

Late Research Chemist, Louisiana Experiment Station, New Orleans.

THE THEORY OF CANE JUICE CLARIFICATION.

The clarification of beet and cane juices is generally considered to be an essentially chemical process, which conclusion may be attributed to the fact that the removal of as large a quantity as possible of all impurities has so far been almost entirely attained by the use of very active chemicals. Most people, however, admit a secondary "mechanical" effect.

NOEL DEERR[2] found that of the total impurities precipitated by heat and lime only 28 per cent. were removed by the chemical reagent, and that by far the greater part were thrown down by heat alone and could even be removed by filtration of the cold juice through asbestos. NORRIS[3] also showed that a large quantity of material could be removed by the Chamberland filter, especially in the case of juice from the last mill. Now, the 28 per cent. of impurities precipitated by the lime may only in part consist of chemical compounds of lime. Even admitting that it does so entirely, it is readily seen that the so-called "mechanical" effect is much more important than the purely chemical one. This conclusion is further strengthened by the fact that filtration of the juice only becomes possible when a large quantity of finely divided precipitate is produced in the juice; and that (what is more important) it does not matter much how this precipitate is produced, whether by adding the lime first or by adding the sulphurous or phosphoric acid first. Certainly, nobody would claim that if we had to do with a purely chemical process it would be immaterial whether the treatment were made first with alkali or alternatively first with acid. All this leads to the inevitable conclusion that the "mechanical" side of clarification is infinitely more important than the chemical effect.

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[1] Editorial summary of *Louisiana Bulletin*, No. 173 of 1920.

[2] *I.S.J.*, 1916, 559.

[3] *I.S.J.*, 1919, 71.

This being so, the next question is, what this mechanical effect consists of, and by what forces it is brought about. Since the impurities precipitated by heat can be removed also by filtration in the cold through specially prepared filters, they are evidently not molecularly dispersed, but in a more coarsely dispersed state. Since they pass through ordinary filters at least for a time, they are probably colloidal. During the last few years evidence has been accumulating that the whole subject of cane juice clarification should be reinvestigated from the standpoint of colloidal chemistry. PRINSEN GEERLIGS[1] probably was the first to call attention to this. He says in substance: "The clarification of cane juice by chemicals does not eliminate from the juice any great amount of impurities, but it is more the improvement of the physical properties which is effected, as for example the removal of the small amount of colloidal matter which hinders the juice from being filtered and keeps afloat the suspended ingredients." SCHNELLER[2] also showed that certain phenomena connected with cane juice clarification should be viewed from the standpoint of colloid chemistry. Only a year ago PECK[3] published an article giving a short outline of what had been done on this subject and made a plea for further investigations.

Unfortunately, we know very little as yet about the colloids in cane juice. Undoubtedly we have to do with a very complex system, in which the dispersion medium is evidently water. Some of the solutes are in a state of molecular dispersion, for instance sucrose, dextrose, levulose and various ash constituents. Others are colloidally dispersed, such as proteids, polyphenol compounds and related colouring matters, clay, very fine particles of fibre. Then there are also coarse dispersoids, like larger particles of soil and of fibre. Between all of these constituents adsorption complexes are probably formed, which further complicate the situation. NOEL DEERR[4] seems to be the only one who has subjected cane juice to a colloid-chemical analysis, and he states that the colloids are lyophilic, charged negatively, irreversible as regards the effect of heat, and reversible in their behaviour towards alkali. This information probably takes into account only a part of the colloids present. Here is then an interesting field for investigation.

However, we already have a sufficient number of data to suggest the true nature of the "mechanical" effect of clarification, and by what forces it is brought about. The fact that, of all the "chemical" processes of clarification, those are the most effective in which a large quantity of finely divided precipitate is formed in the juice; the manner of producing it being unimportant, leads to the suggestion that this effect is due to surface phenomena. There is no doubt that mutual precipitation of colloids and electrical phenomena also play a part, but anyway, both of these are known to be closely associated with surface energy. This theory based on colloidal chemistry permits us to explain the different observations made in connexion with the various methods of clarification described above.

When cane juice is filtered cold through paper or cloth, it passes through at first and the filtrate is cloudy. The colloidal particles are smaller than the pores of the filtering medium, and they go through. But the particles are quickly adsorbed by the filtering medium, and the pores get clogged. The filtration soon becomes very slow, although successive portions of the filtrate are clearer and clearer. If pressure is applied, the colloid particles are again partly driven through the pores, but as soon as the mat becomes thick enough, filtration stops once more. If the juice is heated before attempting filtration, the colloids form larger aggregates, and when the juice is now poured on a filter, the first part of the filtrate is clearer than is the case in cold filtration. But even the larger aggregates of the colloids are non-rigid, soon clog the pores, and filtration stops again. Now, if we use lime in addition to heat, this reagent forms some insoluble lime salts consisting of rigid particles, some of which are at least large enough to be retained by the filtering medium. These particles of lime salts adsorb a part of the colloids, in proportion to their active surface. They also serve now as filtering media, and it is not surprising that a clearer filtrate is obtained, and that more filtrate can be recovered. But the quantity of rigid particles is not sufficient to adsorb all the colloids, and to form a medium sufficiently porous for the liquid to pass readily. In the sulphitation process a much larger quantity of finely divided precipitate is produced than with lime alone, adsorption is increased, and the filtration proportionately facilitated. In the carbonatation process the amount of precipitate is still larger, and here we reach the possibility of perfect filtration, where the colloids are adsorbed to a maximum extent, and where there is a sufficient number of rigid particles to form a porous filtering medium.[1]

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[1] "Practical White Sugar Manufacture," p. 62-3.

[2] *La. Planter*, 1916, 56, 44. [3] *I.S.J.*, 1919, 70. [4] *I.S.J.*, 1916, 502, 558.

If the adsorption theory is correct, it should in fact be possible effectually to clarify cane juices by simply introducing into them chemically inert, finely divided substances of consequently high adsorbing power. If such a process is feasible, it will not only be a strong theoretical argument in favour of the adsorption hypothesis, but would also offer great practical advantages. The carbonatation process is not favoured in Louisiana on account of the danger from an excess of lime, and the sulphitation process when applied to the juice obtained in this State gives very imperfect results, because it does not remove a sufficient quantity of colloids and particularly of colouring matters. This line of reasoning led us to investigate the applicability of chemically inert adsorbents as filtration aids.

CHEMICALLY INERT ADSORBENTS AS CLARIFYING AGENTS.

A great number of such adsorbents have, from time to time, been proposed for use in the sugar industry. Among these are bone-black and other carbons, various forms of silica, clay and similar silicates, gypsum, dolomite, sawdust, paper pulp, peat, bone meal, brick dust, pumice stone, etc.; but of all these only some of the various forms of carbon and of silica have so far been found to be of practical value.

Bone-black is extensively used in the refining industry; the application of modern decolorizing carbons has been the subject of several of our publications during the past few years.[2] The primary effect of these carbons is due to adsorption; it may in certain cases, however, be followed by chemical phenomena.

The use of a small quantity of a good decolorizing carbon added to hot cane juice has such a purifying action on it that it can be readily filtered and emerges as a water-white liquid. This in itself would constitute a satisfactory clarification process provided that no sugar were lost by inversion. But even if the process were safe from this standpoint, it would not be practical. Decolorizing carbons are quite expensive, and the success of their use in the factory depends on the number of times they can be used over and over again, with or without revivification.

Now, if carbon is used on raw juice, it will not only adsorb the highly dispersed solutes in it, but will also become contaminated with all the coarser dispersoids, like particles of soil and fibre, which have passed through the juice strainer. This is liable to decrease its adsorbent effect on the highly dispersed solutes, and also makes it more difficult to revivify the carbon for repeated use.

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[1] Another interesting application of adsorption to the clarification of cane juice is found in the Williamson defecator, where the dispersoids and the air introduced into the juice form adsorption compounds of low specific gravity. These rise to the surface and are easily removed.

[2] *I.S.J.*, 1918, 309, 415; 1919, 86, 250, 284.

It is exactly this consideration which led to the use of these carbons on juice previously clarified by one of the chemical methods. But, fortunately, this pretreatment of the juice, which is necessary for practical reasons, can be effected just as easily by a chemically inert adsorbent as by chemical methods, at the same time avoiding the drawbacks of the latter, mentioned before. It has been found that properly-prepared kieselguhr answers all the requirements. This has for a number of years been employed in the cane sugar industry.[1] FRIBOURG[2] states that the juice obtained by sulphitation or by clarification with di-calcium phosphate can be filtered through presses with the aid of kieselguhr. BACHLER[3] recommends the addition to the juice of clay or similar colloids, which are then coagulated by the addition of another colloid, like protein, or by acidifying with phosphoric acid; kieselguhr is then added to increase the filtrability of the precipitate. A similar process has been patented by KRIEGER.[4] In other processes it is used in a similar way as in the preparation of dynamite, that is as a medium which absorbs large quantities of liquid. Thus BACHLER[5] incorporates hydrogen peroxide with it, and uses this preparation for the decolorization of cane juice. WAYTE[6] absorbs phosphoric acid in the kieselguhr and uses the mixture for clarification; TIEMANN[7] "mordants" the kieselguhr with such chemicals as stannous chloride, followed by neutralization with sodium hydroxide for decolorizing the juice.

In all the processes just mentioned it is not expressly stated that kieselguhr may also be used without simultaneous treatment with chemicals, but this idea readily suggests itself and may have been had in mind by at least some of the authors cited above. It is actually claimed as a new process by WOOSTER.[8] The use of kieselguhr without chemicals was also suggested to us last year by Dr. J. SAUER. This has led us to investigate the possibilities of kieselguhr and decolorizing carbons, singly and combined, for clarification, omitting chemical treatment altogether.

(*To be continued.*)

Trinidad.

Cane Farming and Sugar Crop Returns, 1911-1920.

(Compiled by Edgar Tripp & Co)

Year.	Total Sugar made, tons.	Tons of Sugar made from Estate Cane.	Tons of Estate Cane Ground.	Tons of Cane Purchased	Amount paid for Canes.	No. of Farmers: West Indian.	No. of Farmers: East Indian.
1920	58,416	28,953	319,421	344,226	2,924,404	14,536	10824
1919	47,850	24,656	275,451	270,324	1,210,155	12,370	8568
1918	45,256	22,544	252,783	266,144	812,247	12,158	8244
1917	70,891	36,102	378,999	384,650	1,093,770	12,055	8984
1916	64,231	35,653	426,106	363,775	1,008,665	14,014	8212
1915	58,882	34,376	426,262	325,071	869,790	9,202	7078
1914	55,488	35,690	407,797	201,799	486,630	7,450	5253
1913	42,331	31,095	346,912	136,724	330,364	6,942	5513
1912	40,936	27,856	315,762	151,697	358,428	6,983	6042
1911	46,718	32,599	366,599	165,720	357,560	6,621	6391

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[1] See also Peck, *I.S.J.*, 1918, 322.
[2] *I.S.J.*, 1917, 162.
[3] *I.S.J.*, 1916, 386.
[4] *I.S.J.*, 1918, 577.
[5] *I.S.J.*, 1915, 292.
[6] *I.S.J.*, 1914, 294.
[7] *Zeitsch. Ver. deut. Zuckerind.*, 1914, 64, 52; *I.S.J.*, 1914, 439.
[8] U.S. Patent, 1,304,438; *I.S.J.*, 1920, 113.

Publications Received.

Manufacture of Sugar from the Cane and the Beet. By T. H. P. Heriot. (Longmans, Green & Co., London.) 1920. Price: 24s. net.

Sugar technologists desiring fresh information and new ideas on questions concerned with their subject will be disappointed in this new book contributed by Mr. HERIOT to Sir EDWARD THORPE's series of "Monographs on Industrial Chemistry." A careful perusal of the volume will reveal no original data of any value. Rather, it will show that the information given appears to have been culled, mainly if not entirely, from very well-known sources, such as the works of GEERLIGS, HARLOFF, WARE, PALMER, and others. It would not, indeed, be a difficult matter, when turning over the pages of the book, to indicate the author to whom Mr. HERIOT is indebted largely for descriptions of plant and processes, and other particulars.

Regarded merely as an introductory manual for the student or general reader, one may say that it summarizes a good deal of general information, largely of an elementary character, in a readily accessible form. At the same time, it may be pointed out that the book introduces no new method of discussing the principles of any phase of the subject, and therefore fails to justify its existence on the score of originality of exposition. Moreover, apart from a number of good photographs of the latest and best types of machinery made by British firms, the illustrations are inadequate, several being borrowed from books with which most technologists are familiar. Descriptions of a number of important apparatus are attempted without the use of drawings, and no references are made to sugar periodicals, by means of which further information on the topics treated might be obtained. We are sorry not to be more appreciative of Mr. Heriot's effort; but his book strikes us as being of too unoriginal a character to be regarded as a useful addition to the literature of our subject.

The Jam (Sales) Order, 1920. Ministry of Food (Continuance) Act, 1920; Statutory Rules and Orders, 1920, No. 1512 (H.M. Stationery Office, Imperial House, Kingsway, London, W.C. 2). Price: 1d.

It is ordered by the Food Controller *inter alia* that (1) The water-soluble extract shall not be less than 65 per cent. of the total weight of the jam (jelly, conserve, or marmalade); not more than 10 per cent. of the jam by weight shall consist of added fruit juice; where more than one variety of fruit or vegetable is used (other than in the form of added fruit juice not exceeding the quantity just specified) each such variety must be mentioned in the description, but where any fruits contained in the jam is less than 25 per cent. of the total fruit content, their name shall be prefaced in the description by the words "flavoured with." (2) A person shall not sell any article under the description of marmalade unless either only citrous fruits or citrous fruit juices and sugar have been used, or each variety of fruit or vegetable used is mentioned in the description. (3) A person shall not sell any jam in a container unless it bears the name and address of the manufacturers, and its guaranteed net contents.

Chemical Research. By W. P. Dreaper. Second Edition. (J. & A. Churchill, London). 1920. Price: 7s. 6d.

Chemists will find this a book of particular interest, as we pointed out at the time of the publication of the first edition.[1] It deals with the qualifications which an investigator should possess, giving attention to those which may be developed by training and practice. It also gives suggestions for the guidance of the student, once his knowledge of facts and principles has been acquired, and discusses matters such as the method of directing research, the effect of past experience and the importance of manipulative skill. Consideration is further given to the relation of research to pure science, to industry, and lastly to chemical analysis. The frontispiece to this very excellent book is in the form of a fine steel engraving of one of the most famous of investigators, MICHAEL FARADAY.

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[1] *I.S.J.*, 1913, 284.

(1) Fragmente zur Theorie und Praxis der Kristalle; (2) Beiträge zur Zuckerkristallisation. By L. Wulff. (Kommissionsverlag H. Wehdemann, Parchim, Germany.) Price: 1 Mark each.

Dr. Wulff's name is very well known in connexion with the development of schemes of crystallization-in-motion, of the practical installation of which process he may indeed be regarded as the originator. These two pamphlets, published by the veteran investigator of this very interesting branch of physics, are of the nature partly of an autobiography, partly of an historical account, and partly of a dissertation on the subject generally. They give at the same time a list of the literature published by Dr. WULFF, from which one may have an indication of the valuable work on this subject which he has carried out during his active career. All interested in the subject of crystallization, and especially of the crystallization of sugar solutions, will find much of value in these booklets.

The Boiler Code. Revised Edition. (American Society of Mechanical Engineers, 29, West Thirty-ninth Street, New York, U.S.A.) Price: $1·00 (paper); $1·50 (cloth).

It contains standard specifications for the construction, equipment, and use of steam boilers, and has been adopted as the legal construction code in several States in America. Its standards have also been accepted by many boiler insurance companies, boiler manufacturers, and consulting engineers.

La Gomosis de la Cana de Azúcar. By Julius Matz. (Circular No. 20; Insular Experiment Station, Rio Piedras, Porto Rico.) 1920.

Contents: Discovery of the gumming of sugar cane in Porto Rico; history of the disease; its recognition; its cause (a bacterium, *B. vascularum*[1]); recommendations regarding control; and publications on the subject.

Among other recent publications are the following:

Aliments Sucrés. Dr. E. Roux and Dr. C. F. Muttelet. (Ch. Béranger, Paris.) 1920.

Mining and Manufacture of Fertilizing Materials. Strauss L. Lloyd, E.M. (Crosby Lockwood & Son, 1919.) 1919. Price: 9s.

Handbuch der landw. Pflanzenzüchtung. Prof. Dr. C. Fruwirth. **Die Züchtung der vier Hauptgetreidearten und der Zuckerrübe.** Vol. iv. Third revised Edition with the collaboration of Prof. Dr. E. Tschermak and Dr. Th. Roemer. (Paul Parey, Berlin.) 1919. Price: M. 30.

Die Abwärmeverwertung im Kraftmaschinenbetriebe. Dr. Ing. Ludwig Schneider. Third revised Edition; 159 illustrations. (Julius Springer, Berlin.) 1920. Price: M. 20 plus 20 per cent.

Der Kampf zwischen Rohr-und Rübenzucker. Dr. T. Zeller. (Verlag K. F. Kohler.) 1920. Price: M. 7.

Entstehung und Ausbreitung der Alchemie. Prof. Dr. E. von Lippmann. (Verlag von Julius Springer, Berlin.) 1919. Price: M. 45.

Die Runkelrüben-Zucker-Fabrikation. 1919. Edited by the Verein der deutschen Zucker-industrie. (Verlag von Paul Parey, in Berlin.)

Die Zukunft der Cecho-slovakischen Zuckerindustrie. Dr. Felix Redlich and Dr. Siegmund Ziegler. (Published by the Authors, in Brünn.) 1919.

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[1] *I.S.J.*, 1919, 196.

Review of Current Technical Literature.[1]

EXTRACTION OF SUGAR FROM FINAL MOLASSES. *J. N. S. Williams.* *Facts about Sugar, 1920, 11, No. 2, 30-31.*

In the course of an article entitled "Progress in Extraction and Recovery in Hawaii," read before the Hawaiian Chemists' Association in April, 1920, Mr. WILLIAMS discussed the theory that it is not the glucose, gum, ash, or other substances that prevent the crystallization of the sugar, but simply the water, which retains it in solution. An animated correspondence has been carried on in this *Journal* relative to this matter,[2] and that there is foundation for the new view appears to be demonstrated by the following facts:—

Since 1914 a number of plantations have adopted the plan of boiling final molasses to a density of 96° Brix and upwards, running the charge into crystallizers or tanks to allow graining to occur. After passing the massecuites obtained through a pug mill, thinning down with a dilute solution of final molasses, and purging, an average final molasses of very low purity has been obtained. At the Experiment Station of the H.S.P.A. very low grade molasses was concentrated to a high density and "seeded" with a proportion of exceedingly fine-grained sugar, crystallization being thus stimulated and expedited. However, the crystals obtained in this way are so minute as practically to preclude the recovery of the sugar obtained by methods at present in use; but the purity of the molasses finally resulting is considerably lower than has hitherto obtained. In these tests of the Experiment Station, final molasses from a number of factories having a gravity purity of 35° was concentrated to 99·1° Brix, and seeded with fine grain, this addition bringing up the purity to 44·5°. The final molasses taken off by means of a special machine had a density of 88·55 Brix and a gravity purity of only 31·98°.

TWO BOILING SCHEMES USED IN JAVA. *G. E. G. von Stietz.* *La. Planter, 1920, 65, No. 6, 92-93.*

Formerly (as in 1916-17) in the Sempalwadak factory the author boiled four successive strikes, details of which are as follows: *First*, using syrup of 85-90° purity from the evaporators with some returned molasses sugar, the Brix being 92-23° and the purity 85-90°; *second*, using syrup, molasses from the first strike, and some returned molasses sugar, the Brix being 93-94° and the purity 80°; *third*, using syrup and molasses from the second strike, the Brix being 94-95° and the purity 70°; and *fourth*, using syrup and molasses from the third strike, the Brix being 98-99° and the purity 60°, lastly obtaining a waste molasses of about 32° apparent purity. The first, second, and third crops of sugar were mixed together, and gave a product averaging 98·0-99·4° polarization and a colour of 16-20 D.S.; while the fourth crop of sugar was returned (as mentioned) to build up the first and second strikes. He states, however, that difficulty was experienced owing to the unexhausted molasses remaining too long in circulation, and that the curing of the fourth massecuite was often faulty. Further, the black fourth sugar by being returned to the first and second strikes re-introduced a certain amount of very viscous molasses, and it was found after a time that the polarization of the mixed raw sugar did not reach 98°. In the early part of the season matters went well enough, but latterly as the circulating molasses became more and more gummy, work became more and more difficult.

Therefore another scheme (illustrated below) was followed, in which the exhaustion of the molasses was more direct. In this method of boiling, the quantity of the first boilings is much greater than that of the second and third, since in the first all the evaporator syrup is used, and also all the sugar obtained in the second and third strikes. Thus, all the merchantable sugar originated from the first boilings, giving a very good and regular quality of sugar; while in each strike the molasses was readily separated. In the first strike, boiling was easy, since it was not required to granulate, but only to evaporate the mixture of returned molasses, sugar and syrup to a sufficient degree and take in more

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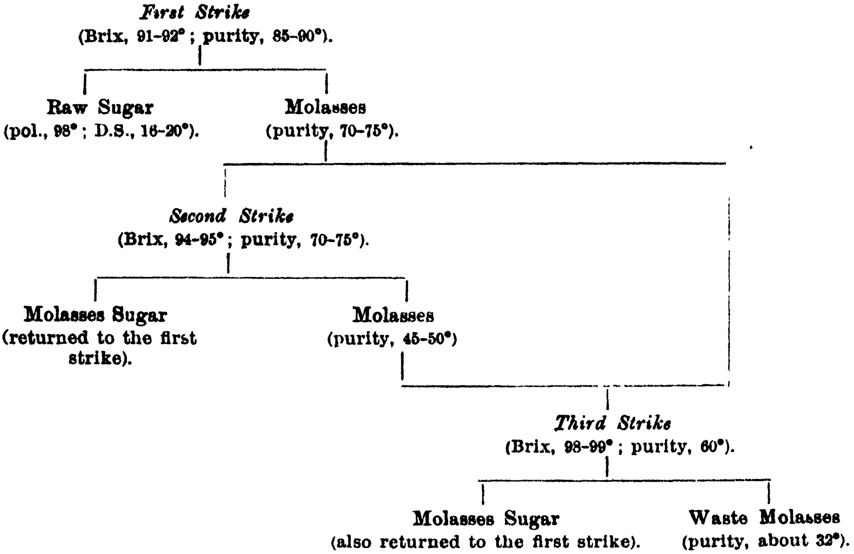
[1] This Review is copyright, and no part of it may be reproduced without permission.—(Editor, *I.S.J.*)

[2] *I.S.J.*, 1917, 90, 159, 297, 568; 1918, 86, 328; and 1919, 138.

syrup until the pan was full and until the massecuite could be taken down to the crystallizers. As is shown, the second strike was boiled with first molasses alone, and the third strike with first and second molasses. Generally a waste molasses of 30-32° will be obtained by this procedure; but at Sempalwadak it was found impossible to get a molasses having a purity less than 34-35°, the reducing sugars being very low and the ash content high.


First Strike
(Brix, 91-92°; purity, 85-90°).
Raw Sugar
(pol., 98°; D.S., 16-20°).
Molasses
(purity, 70-75°).
Second Strike
(Brix, 94-95°; purity, 70-75°).
Molasses Sugar
(returned to the first strike).
Molasses
(purity, 45-50°)
Third Strike
(Brix, 98-99°; purity, 60°).
Molasses Sugar
(also returned to the first strike).
Waste Molasses
(purity, about 32°).

DORR AND WILLIAMSON CLARIFIERS FOR USE IN THE FACTORY AND REFINERY. *W. D. Horne. Abstract of a paper read before the American Chemical Society, September, 1920.*

The DORR clarifier[1] has recently been used for the continuous treatment of juice in Cuba. It is essentially a cylindrical apparatus 18 or 20 ft. in diameter, consisting of superimposed settling compartments equipped with slowly revolving scraper mechanisms and fed through a central loading-well, into which hot limed juice flows continuously. It is arranged so that the inflowing juice produces no appreciable disturbance of the liquor already in the compartments, with the result that the suspended and precipitated matters slowly settle and are moved to the central outlet in the bottom of the apparatus, while the clear juice overflows through numerous pipes in the outer walls of the compartments. This juice has been found to be very much clearer and freer from suspended impurities than that ordinarily prepared in the older type of intermittent settling and decantation tanks. The mud after removal is diluted with hot water and filter-pressed, giving a dense cake, while nearly all of the sugar is retained in the water separated. Compared with the system now in vogue, the advantages of this process lie in the greater cleanliness of the sugars produced, the greater economy of time, labour and fuel, and the smaller loss of sugar.

The WILLIAMSON clarifier[2] is coming into use for treating the heavier solutions worked in the refinery, and is also a continuously acting device, but separates the impurities by flotation instead of by sedimentation. Raw sugar liquor is treated with a small amount of clarifying agent such as milk-of-lime, etc., and then forced through an aerating device under high air pressure to charge it with a great multitude of minute air bubbles. As this is done at a comparatively low temperature, the air bubbles do not readily separate from the viscous sugar solution. This solution is next passed into a long shallow tank containing suitable baffles and steam pipes, where it is gradually heated nearly to the boiling point

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[1] *I.S.J.*, 1920, 584.

[2] *I.S.J.*, 1919, 525; 1920, 114.

in its passage to the outlet end. The gradual heating causes the minute air bubbles to expand and rise to the surface, carrying with them all the suspended matters in the sugar liquor, which scum is very persistent and gradually moves toward the outlet end, where it is brushed away into a compartment, while the clarified solution is also continuously syphoned off. The clear liquor goes on the boneblack filters, and the scums are diluted and filter-pressed. This method entirely does away with the use of bag filters and all their accompanying uncertainty, inconvenience, and expense.

INVERSION OF SUCROSE IN PLANTS BY THE ACIDS OF THE JUICE. *H. Colin. Comptes rendus, 1920, 171, No. 5, 316-318.*

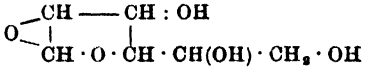
In a large number of fruits containing sucrose, free acids are present in more than the amount necessary to effect the inversion of the disaccharide, a fact which may at first occasion surprise. Thus, if the rate of hydrolysis in the case of the juice obtained from an orange or lemon be compared with that of a solution containing the same amount of sucrose and free acid, it will be found that at the end of say 10 hours all the sugar will have been inverted in the second artificial solution, and only about one-third in the natural. ABBOT COLIN has examined this interesting point, and explains the facts observed (which he has verified) by the presence in the juice of alkali salts (as potassium citrate, malate, etc.), which hinder the hydrolysing effect of the free acid. He was easily able to demonstrate this by recording the diminution in the rotation of (1) an orange juice, (2) a solution of sugar containing the same amount of sucrose and free vegetable acid, and (3) a solution containing in addition to the same amount of sugar and acid, some potassium citrate. Initially, the readings were 6° 45′, 6° 44′, and 6° 40, respectively, but at the end of ten hours they were seen to be + 2° 45′,—1° 45′, and + 2° 12′.

DETERMINATION OF REDUCING SUGARS, USING THE ALUNDUM CRUCIBLE. *D. T. Englis. Journal of Industrial and Engineering Chemistry, 1920, 12, 799-800.*

MEADE and HARRIS,[1] as well as other workers, recommend the use of crucibles made of porous alundum ware (instead of the ordinary porcelain Gooch) for filtering off the cuprous oxide in the determination of reducing sugars. Difficulty was experienced by the writer, however, in effecting a complete washing, there being a tendency for the cupric liquor to climb to the upper edge, and escape removal, though this irregularity could probably be removed by employing a Spencer filtering apparatus.[2] As one of these was not at hand, the procedure adopted was to secure the crucible in a funnel by means of an inverted Sargent holder, and wash completely in the usual way; while to remove the last traces of copper salt remaining in the rim, a moistened rubber stopper was pressed down on top of the crucible, water poured on top of the holder and around the stopper, and suction applied. In this way the water was drawn from outside the crucible through the top rim, and a complete washing thus effected.

GLUCOSAN. *Amé Pictet and Pierre Castan. Comptes rendus, 1920, 171, No. 4, 243-245.*

Glucosan is regarded as an anhydride of glucose,[3] from which it is prepared in a pure state by heating to 150-155° C. under reduced pressure. It melts at 106-110° C., and analysis gives the formula $C_6H_{10}O_5$. Its $[\alpha]_D$ is + 69·8 for a concentration of 3·84 per cent., and it reduces Fehling's solution. Heated with water, it is transformed into glucose, and its most remarkable property is the formation of additive compounds. It gives halogen bodies, a tribenzoyl derivative, and a crystalline bisulphite compound. When dissolved in methyl alcohol, and saturated with hydrochloric gas, it is converted into a methyl glucoside. It is given the following constitution :—



$$\mathrm{O}\begin{array}{l}\diagup\mathrm{CH}\text{——}\mathrm{CH : OH}\\ \ \ |\qquad\quad\ \ |\\ \diagdown\mathrm{CH\cdot O\cdot CH\cdot CH(OH)\cdot CH_2\cdot OH}\end{array}$$

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[1] *I.S.J.*, 1917, 527.

[2] *J. Ind. Eng. Chem.*, 1912, 4, 614; Dr. SPENCER uses a special funnel, in which the crucible is held by a rubber ring touching, not its sides, but its upper edge only. All parts of the surface of the crucible are thus accessible for washing.

[3] *Comptes rendus*, 1860, 51, 331.

"CAA-EHE," A PLANT CONTAINING SUBSTANCES 150 TO 180 TIMES SWEETER THAN SUGAR.

Anon. *Bulletin of the Imperial Institute, 1920, **18**, No. 1, 123-125.*

"Caa-ehe," or *Stevia Rebaudiana* (Bert.) Hemsl., a herbaceous perennial, occurs along the base of the Amambay hills in North-Eastern Paraguay, where it is used by the natives as a sweetening agent. It is found in a rich black sandy soil, never more than 100 yards from running water or swamp, and is very sensitive to cold. Attempts have been made to cultivate it, but according to JIMENEZ[1] the plant does not grow easily from cuttings, and as a rule is not reproduced from seed. BERTONI, who has devoted considerable attention to the plant[2], states that multiplication by division of the stalk is comparatively easy, and that it can also be propagated by cuttings and suckers.

It has been proposed as a substitute for saccharin; and the sweet principle is a glucoside, first termed "eupatorin," but now "estevin," which is stated to be accompanied by another sweet constituent named "rebaudin," which latter is probably a compound of estevin with potassium and sodium.[3] These two constituents are said to be respectively 150 and 180 times as sweet as cane sugar.[4] Together with wax, resin, and oil there is also present a bitter principle, which can be easily separated from the glucoside. It is believed, however, that the glucoside could not be extracted profitably; and that the only way of utilizing the material is to employ the powdered leaves. A plantation has been established in Paraguay by Señor JIMENEZ, who is stated to be in a position to supply the plants ready packed for transport.

ABSORPTION OF COLOURING MATTERS BY DECOLORIZING CARBONS AND ANIMAL CHARCOAL.

Edmund Knecht. *Journal of the Society of Dyers and Colourists, 1920, **36**, No. 7, 201.*

Philip, Dunnill and Workman recently made the statement[5] that "attempts have been made[6] to correlate the activity of a charcoal with its nitrogen content, but the probability of such a relationship must be regarded as exceedingly small in view of the above figures for a wood charcoal. . . ." This referred to a paper written by the author, and he now denies having implied anything to this effect, having in fact expressly mentioned that the percentage of nitrogen does not appear to affect this property, so far as methylene blue (a basic colour) is concerned. In the case, however, of an acid colour, as crystal scarlet, the absorptive power *of animal charcoal* is proportional to the amount of fixed nitrogen present, which contention has not been controverted so far. It is believed that the absorption of methylene blue is in some way connected with the oxygen content of the bone char, and until it has been proved that pure amorphous carbon will act in this way the phenomenon must be attributed to chemical and not to mechanical means. In passing, it is mentioned that a sample of black obtained by exploding acetylene (diluted with carbon dioxide to diminish the shock) was found to have no affinity for methylene blue, and in fact was practically devoid of decolorizing power

COST OF PRODUCTION OF INDUSTRIAL ALCOHOL FOR MOTOR FUEL. *A. P. H. Desborough.*

*Journal of the Society of Chemical Industry, 1920, **39**, No. 17, 302-303 R.*

In an address given before the British Association at its recent Cardiff meeting, Capt. Desborough said that the Lonza firm making alcohol from calcium carbide[7] had contracted to supply rectified spirit to the Swiss Federal Government at about 1s. per gall., but it is understood that the factory has now been closed down, owing to business proving unprofitable. In regard to production from the ethylene present in coke oven gases[1], its value is put down at 2s. per gall. According to a report of the Honorary Advisory Council for Scientific and Industrial Research, of Canada, the sulphite liquor from all the pulp mills in the Dominion could supply 5 million gall. per annum at a cost of about 1s. 6d.

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[1] *Revista de la Escuela de Comercio*, 1917, **8**, 633.

[2] *Anales Cientificos Paraguayos*, 1918, January, *Agricultural News*, 1918, **17**, 213.

[3] "Eupatorin" is the name given to the toxic bitter principle occurring in *Eupatorium perfoliatum*.

[4] Other references to this glucoside are: RASENACK, *Chem. Centr.*, 1908, (2), 78; and DIETERICH, *Chem. Centr.*, 1909, (2), 459.

[5] *I S.J*, 1920, 346-347.

[6] GLASSNER AND SUIDA, *Annalen*, 1907, 95; E. KNECHT, *Jl. Soc. Dyers and Col.*, 1916, 226.

[7] *I.S.J.*, 1919, 141, 144, 521.

Fermentable carbohydrates so far appear to be the cheapest source of the production of industrial alcohol. To place spirit on the market at say 3s. 2d. retail, the manufacturer would have to sell at 2s. 2d., as 1s. would be absorbed by distribution and other charges. The cost of manufacture of 95 per cent. alcohol by fermentation in a modern factory might be put at 9d., including depreciation on plant. If the wholesale price were 2s. 2d., this would leave 1s. 5d. to pay for raw materials and interest on capital. Taking 4d. for the latter purpose, there is 1s. 1d. for the raw material. As on an average 120 gall. are obtained from 1 ton of fermentable carbohydrates, it would seem that the maximum price which could be offered per ton of pure carbohydrates is £6 10s., delivered to the factory. In the following table are given the corresponding prices (based on the carbohydrates present) for some of the most common crops:

MAXIMUM PRICE PAYABLE PER TON.

Fermentable Carbohydrates, 100 per cent	Jerusalem Artichokes	Potatoes	Mangolds	Sugar Mangold, 13 per cent. Sugar	Maize	Rice
£6 10 0 ..	£1 3 0 ..	£1 3 0 ..	£0 11 0 ..	£0 17 0 ..	£4 8 0 ..	£4 17 0

It is obvious that with present prices for potatoes, artichokes, or mangolds, it would be impossible to attempt the manufacture of cheap alcohol, though the cost of their cultivation might later be reduced. Maize to-day is offered at about £20-£25 per ton; but in Peru and countries where 2 or 3 crops can be obtained yearly, it could probably be produced somewhere about £2 per ton. At the Royal Naval Cordite Factory, Holton Heath, experiments are being conducted on the cultivation of a special Vilmorin beet, a tuberous plant (a *Helianthus*) named *Polymnia edulis*, said to produce roots 0.5 to 2 lb. in weight with a sugar content superior to mangolds. Further, the possibility of dealing with cellulose on parallel lines to the Boulard process[2] was being studied.

ALCOHOL AND ACETONE AS MOTOR FUELS. *E. de Barry Barnett. Chemical Age, 1920, 3, No. 64, 254-255.*

It is interesting to compare the heats of combustion of various fuels. The mileage, i.e., ton miles per gall., depends on the number of calories liberated by the combustion of one *cubic centimetre* of the fuel. The power developed, on the other hand, depends, not only on the heat liberated by the combustion of one *grm.*, but also on the number of grms. that can be burnt in the cylinder at each stroke. In the following table (in which the figures are only approximate) "mileage ratio" is expressed as the heat of combustion of 1 c.c. of the fuel; "combustion ratio" as the number of *grms.* of fuel which can be completely burnt by 1000 c.c. of air, and "power ratio" as the product of the "combustion ratio" and the heat of combustion of *one grm.* of the fuel.

	Mileage Ratio	Combustion Ratio	Power Ratio
Petrol (Heptane)	7·94	2·02	2·32
Benzene	8·8	2·24	2·24
Hexahydrobenzene	6·8	2·08	2·31
Alcohol	5·6	3·36	2·37
Acetone	4·13	3·25	2·44

Acetone can be produced by the fermentation of cellulosic substances (waste straw, heather, bracken, etc.), using a thermophylic organism growing at about 60° C., which produces acetic acid, from which conversion is a fairly simple operation.[3]

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[1] *I.S.J.*, 1920, 168. [2] *I.S.J.*, 1916, 49; 1918, 576; 1919, 411.

[3] Langwell's Patents, U.K Applications, 694 and 8115 of 1920 (not yet published). Shareholders of the Power Gas Corporation, Ltd., in May last were invited to subscribe to a new company to be called Power Spirit, Ltd., in order to develop these patents.

ALCOHOL DENATURANTS. ***James J. Dobbie.*** *Report drawn up for the Motor Fuel Committee; Journal of the Society of Chemical Industry, 1920, 39, No. 5, 86-88R.*

Sir JAMES DOBBIE (Chief Chemist, Government Laboratory) summarizes the position in the United Kingdom in regard to denaturants, pointing out that the chief conditions which such a substance should fulfil are: (1) it should impart a taste or smell sufficiently disagreeable to prevent the alcohol from being drunk, even after dilution, sweetening, and flavouring; (2) it should not be capable of being eliminated easily by filtering, distillation or other readily applied process; (3) it should be capable of being easily and certainly detected; (4) it should mix readily with the spirit without altering its properties in manufacturing operations; and (5) its addition should not materially add to the cost of the denatured alcohol. While many substances fulfil one or more of these conditions, no single product has yet been discovered which meets all satisfactorily. That which approaches most nearly to a perfect denaturant is crude methyl alcohol, or wood naphtha, which is used by all European countries, the British Colonies, and has also been adopted in the United States. It only partially fulfils the first condition (even 10 per cent. does not prevent the spirit being drunk); but it generally meets the second, third, and fourth conditions. In regard to the fifth, however, the position is not quite satisfactory, as the denaturant increases the cost of the spirit. Owing to the fact that wood naphtha is insufficiently nauseous to render the alcohol impotable, it is usually employed in conjunction with another denaturant, as pyridin, or mineral naphtha; and in the United Kingdom the alcohol known as "mineralized methylated spirit" (sold to the public for burning and household purposes) contains 90 parts of ethyl alcohol and 10 parts of wood naphtha with the addition of ⅜ per cent. of mineral naphtha and sufficient dye to give it a violet tint. Such a mixture becomes milky on dilution, and is so nauseous that it is almost undrinkable even when sweetened or flavoured. The denatured alcohol known as "industrial methylated spirit" (in general use for manufacturing operations) contains 95 per cent. of ethyl alcohol and 5 of wood naphtha, and is not undrinkable when diluted, sweetened, or flavoured, so that greater precautions have to be taken by the Revenue authorities to prevent its illegal use. Figures are given in regard to the cost of producing mineralized methylated spirit, and from these it is seen that in the years 1914 and 1919 the selling price was 2s. 1½d. and 7s. 2¾d. per bulk gallon of 91 per cent. strength (60 o.p.); that the average price of wood naphtha was 2s. 1d. and 11s. 6d. per bulk gallon; that the increase of cost of the denatured spirit due to 10 per cent. wood naphtha was 0·64d. and 5·16d.; and that the selling price per gallon of denatured spirit was 2s. 7d. and 9s. 6d. It is also mentioned that the committee appointed to enquire into the Production and Utilization of Power Alcohol in Australia has reported in favour of the use of the distillate obtained from coal tar oil at a temperature of 170 to 230° C. as a suitable denaturant.[1]

ANALYSES OF REFINED SUGARS (DETERMINATION OF MOISTURE, SUCROSE, REDUCING SUGARS, ASH, ACIDITY OR ALKALINITY, AND SIZE OF GRAIN). ***Frederick J. Bates (and associates).*** *Paper read before the Sugar Section of the American Chemical Society, at Chicago, September, 1920.*

Sucrose was determined with the use of a Bates polariscope of variable sensitiveness, readings being possible to about 0·02°S. Reducing sugars were found by means of the Ost copper carbonate liquor,[2] making possible the detection of 0·003 per cent. Ash was ascertained in platinum dishes on 10 grm. samples, using sulphuric acid, incinerating in an electric furnace, and dividing the weight obtained by 1·1 to correct for the sulphate radicle. Moisture was obtained on 2 grm. on a vacuum oven at 70°C. These determinations applied to 220 samples representative of 40 different grades revealed the fact that most of the white refined sugars were of remarkable purity, whether of cane or beet origin, the polarizations averaging about 99·95° with scarcely more than 0·05 per cent. of invert sugar, the ash and moisture being correspondingly low. There was a well-marked tendency for the beet sugars to polarize a trifle higher, so that some of these samples yield results a few hundredths of a degree above 100°, probably due to the influence of high polarizing substances, such as raffinose.

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[1] Compare also *I.S.J.*, 1920, 585.

[2] *I.S.J.*, 1920, 107.

Regarding the reaction of the sugars (of great significance, especially to candy manufacturers), it was found that the electrical method of indicating the hydrogen on concentration was rather too complicated for use in most laboratories, Therefore, the method depending upon certain organic indicators, as developed by Clark and Lubbs, was employed, and dibrom sulphon phthalein found to be suitable for most samples, and dibrom cresol purple for the more acid ones. Standard solutions of potassium acid phosphate were used with the indicators for the purpose of an exact comparison in the titration. In carrying this out, 26 grms. of the samples were dissolved in neutral water; made up to 50 c.c., and 10 c.c. titrated with N/10 hydrochloric acid or sodium hydroxide using four drops of the indicator, which turned deep blue in alkaline and yellow in acid solutions· It was found that cane sugars are nearly always acid and beet sugars sometimes so. The remaining 40 c.c. of the sample solution were titrated with N/10 solution of barium hydroxide, the amount required ranging from 0·08 to 0·15 c.c. Great irregularity of relation of hydrogen on concentration to acidity by titration was observed.

In estimating the size of the grain, the sugars were shaken for five minutes in a rotation machine on a nest of sieves up to 200 mesh per linear inch. An unexpected result of these tests was that extreme variations exist in samples of sugars sold under the same nomenclature by different manufacturers. In the candy test, in which a solution of the sample was boiled under prescribed conditions until 177°C. was reached, and then cooled suddenly, it was found that hydrolysis was generally less than one per cent. in beet, but as much as 15 per cent. in some cane sugars. Work is now under way in regard to colour determination.

Sugars in Cattle Foods. *S. Hoare Collins and Arnold Spiller. Journal of the Society of Chemical Industry, 1920, 39, No. 5, 66 T.*

Kellner appears to have ignored the value of the sugars in fodder and meals, and the superiority of early cut over late cut oat straw is probably due to the greater content of this constituent in the former, rendering it more palatable and nutritious. On examining samples of oat straw the following results expressing total sugars (mostly invert) were obtained : cut before ripe, 5·6; cut green, 18 months ago, 2·89; cut fully ripe, 18 months ago, 1·5 per cent. Earth nut cake, palm kernel cake, and castor cake were found to contain 8·46, 5·05, and 4·63 per cent. respectively.[1]

Extraction of Lactose (Milk Sugar) from Whey. *H. E. Woodman. Journal of Agricultural Science, 1920, 10, 1-11.*

By nearly neutralizing with sodium hydroxide, evaporating *in vacuo* to about one-tenth, and allowing to crystallize, a yield of 75 per cent. of the lactose present was obtained.

Analysis of Maple Products. *J. F. Snell. Transactions of the Royal Society of Canada, 1919, 13, (iii), 221-231.*

This paper deals with the composition of maple syrup; maple sugar sand (which contains 70 per cent. of calcium malate); and the detection of adulteration of the syrup with refined sugar, etc.

Distillation Plant, with Special Reference to the Rectification of Alcohol. *Stephane Masfaraud. Journal of the Society of Chemical Industry, 1920, 39, No. 17, 299-305 T.*

An account is given of some of Barbet's apparatus for the rectification of alcohol and other volatile liquids.

Specific Rotation of Levulose. *W. C. Vosburgh. Journal of the American Chemical Society, 1920, 42, 1696-1704.*

Its variation over concentrations from 2·6 to 20 grms. per 100 c.c., and over temperatures from 15 to 37°C., is given.

J. P. O.

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[1] See also Bodmer, *Analyst*, 1920, 45, 18.

Review of Recent Patents.[1]

UNITED STATES.

Extraction of Sugar from Cane by Presses. *Cornelis D. van Raalten*, of Java. *1,326,231*. Patented, December 30th, 1919. See also U.K. Patent, *130,871*.[2]

Centrifugals. (1) *Tandy A. Bryson*. *1,311,871*. Date of application, November 13th, 1916; patented, August 5th, 1919. (2) *Tandy A. Bryson*. *1,331,692*. Date of application, December 31st, 1917; patented, February 24th, 1920. (3) *Guy H. Elmore*. *1,334,023*. Date of filing, October 7th, 1916; patented, March 16th, 1920.

Beet Harvesters. (1) *John Devey (assignor to the Idaho Sugar Co.)*. *1,331,957*. Date of application, July 6th, 1918; patented, February 24th, 1920. (2) *Silas A. McDowell*. *1,333,324*. Date of filing, August 21st, 1917; patented, March 9th, 1920. (3) *Peter J. Clereman*, of Kenooha, Wis., U.S.A. *1,342,705*. Date of filing, March 15th, 1919; Patented, June 8th, 1920.

Feeding Chocolate Tablets to Wrapping Machines. *Richard Leumann*. *1,330,639* Patented, February 10th, 1920. See also U.K. Patent, *127,828*.[3]

Filter-presses. *George F. Miller*. *1,333,869*. Date of filing, June 7th, 1919 patented, March 16th, 1920.

Filter-press. *Harry T. Shriver*, of Llewellyn Park, West Orange, N.Y., U.S.A. *1,342,829*. September 22nd, 1919; June 8th, 1920.

In a plate-and-frame filter-press, claim is made for the combination of a feed channel connected to each of the frames, a wash channel connected to each alternate plate, each plate having an outlet and a cock to control the same, and automatic means to prevent the flow of liquid from the alternate plates to the wash channel while permitting the flow of fluid from the wash channel to the alternate plates.

Filter-press. *Earl F. Atkins*, of Arlington, N.Y. (assignor to *Harry T. Shriver* of West Orange, N.Y., U.S.A.). *1,342,839*. June 23rd, 1919; June 8th, 1920.

Filter Casing. *Ernest J. Sweetland* (assignor to *United Filters Corporation*, of Delaware, U.S.A. *1,343,182*. March 15th, 1915; renewed, June 6th, 1919; June 8th, 1918.

Claim is made for the combination of a filter member, a filter casing divided into complemental sections, means for fixably supporting the filter member independently of the casing, and means for boldly moving the casing sections linearly toward and away from the filter member.

Adhesive containing Dextrinized Starch. *Walter Alexander*, of New York, U.S.A. *1,337,382*. March 13th, 1917; April 20th, 1920.

Claim is made for an adhesive composition containing dextrinized starch substantially free from glucose and calcium chloride.

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[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States:* Commissioner of Patents, Washington, D C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 2fr 00 each).

[2] *I.S.J.*, 1919, 580. [3] *I.S.J.*, 1920, 59.

Patents.

FILTER CASING. *Ernest J. Sweetland and Carrol M. Stanley* (Assignors to United Filters Corporation, of Brooklyn, New York, U.S.A.) *1,337,733.* June 19th, 1918; April 20th, 1920.

FILTER-PRESS FRAME. *George F. Miller*, of New York, U.S A. *1,337,251.* June 17th, 1919; April 20th, 1920.

BEET HARVESTERS. *Merrell S. Montague*, of Rigby, Idaho, U.S.A. *1,337,481.* June 10th, 1918; April 20th, 1918.

FILTER. *Ernest J. Sweetland*, (Assignor to United Filters Corporation, of Delaware, U.S.A.) *1,344,215.* July 2nd, 1913; June 22nd, 1920.

Claim is made for the combination in a filter of a casing, a plurality of spaced leaves therein, and an inclined pipe interposed between adjacent leaves, said pipe having means for projecting a uniform stream of fluid against a face of the leaves and toward the bottom of the leaves.

ROTARY CRUSHING MILL. *Lafayette Ross*, of East Lynn, Va., U.S.A. *1,340,407.* August 6th, 1918; May 18th, 1920. (Five figures.)

In regard to a mill for crushing cane (presumably for small scale operations) claim is made for the combination with a frame of upper and lower series of crushing rollers, the upper series of rollers being carried in a vertically movable frame, gear connexions between the upper and lower rollers, gear connexions between the rollers of the upper series of rollers, means for driving one of the rollers of the upper series of rollers whereby all of the rollers of both series will be rotated during a crushing operation, means between the rollers of each series for preventing the cane from passing through the vertically disposed spaces between the rollers, the vertically movable frame carrying the upper series of rollers allowing said upper series of rollers to be thrown out of gear connexion with the lower series of rollers when an excessive amount of material is fed between the rollers.

BEET TOPPER. *Walter L. and Fred L. Johnson.* *1,341,909.* July 12th, 1916; June 1st, 1920.

MACHINE FOR STIRRING MAPLE SUGAR. *Michael Handner*, of Tolland, Mass., U.S.A. *1,341,743.* January 29th, 1920; June 1st, 1920.

BEET BLOCKER. *Siegfred Nordenber and Stephen Donner*, of Jennings, Mich., U.S A. *1,346,332.* June 16th, 1919; July 13th, 1920.

BEET HARVESTER. (1) *Wm. K. Lewis and David T. Blevins*, of Denver, Colo. (Assignors to the *National Beet Harvester Co.*), U.S.A. *1,346,322.* July 22nd, 1918; July 13th, 1920. (2) *Walter B. Smith*, of Springfield, Ohio, U.S.A. *1,347,596.* September 17th, 1915; July 27th, 1920.

BEET TOPPER. *Asa H. Ballard*, of Fort Morgan, Colo., U.S.A. *1,344,849.* June, 23rd, 1919; June 29th, 1920.

CENTRIFUGAL. *F. M. Watkins*, of Cincinnati, Ohio, U.S.A. *1,325,064.* August 9th, 1916; renewed, October 26th, 1917; December 16th, 1919.

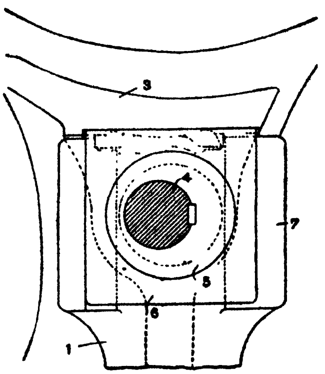
The side wall of the basket is inclined upwards and outwards, so that material within tends to be discharged over the rim during rotation. Means are provided for preventing such discharge of solids while permitting discharge of liquid, such means having radial partitions projecting inwards into the basket and rotating with it. The solids may be discharged by an axial movement of the restraining means.

UNITED KINGDOM.

ADJUSTMENT OF THE TRASH TURNER OF CANE MILLS. *James Miller and George Fletcher & Co., Ltd.*, of Derby. *141,078* (*11,167 of 1916*). August 8th, 1916; April 15th, 1920. (Two figures.)

Hitherto the adjustment of the bar carrying the trash plate has been obtained by devices on each end of the bar operated independently and separately of each other. According to this invention, means are provided for adjusting the bar, and thereby the trash turner blade carried by it, simultaneously at both its ends, and from the open side of the mill.

Referring to the drawing the device is shown applied by way of example to a known form of eccentric adjustment for trash turner plates which *per se* forms no part of the present invention. The trash turner *1*, which may be of any desired form, is mounted on the lower part of the framing between the two lower rolls in the case of a three-roller mill, in the usual manner. On its upper surface it carries the blade *3* bolted or otherwise secured to it. Adjacent its upper edge a shaft *4* is passed through it, which shaft *4* carries an eccentric *5* engaging a bush on each side of the mill adapted to slide in guides *7* on the trash turner *1*. It will consequently be seen that by rotating the shaft *4* the trash turner blade *3* would be moved either to one side or the other. The shaft *4* passes through the headstock and carries a worm wheel on the side of the mill opposite to that carrying the driving gearing. The worm wheel is adapted to mesh with a worm provided with a handle, or with tommy holes, or other means whereby it may be rotated. Consequently, whenever the trash turner blade requires adjusting, this may be simply effected by a turning of the worm from the open side of the mill without necessitating the stoppage of the same. In order to protect the adjustment mechanism consisting of the eccentric bush *5* and block *6*, a guard plate is provided which shrouds this adjustment mechanism by directing the juice away from it.



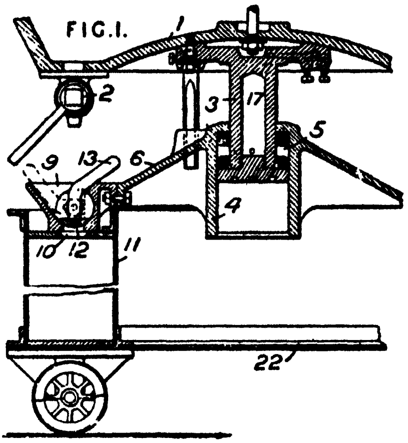
MANUFACTURE OF DEXTROSE, FURFURAL, AND METHYL ALCOHOL FROM MATERIALS CONTAINING CELLULOSE. *A. Classen*, of Aachen. *142,480* (*11,691*). April 27th, 1920; convention date, March 18th, 1919; *not yet accepted.*

In the manufacture of furfural, methyl alcohol, and easily fermentable sugars from materials containing cellulose, a larger yield is obtained by the addition of a small quantity of an acid or acids besides the acid required for the conversion purpose. Hydrochloric, sulphuric, sulphurous, and hydrofluoric acids are suitable, or acid salts, or salts decomposed by excess of acid or hydrolytically, e.g., chlorides of magnesium, calcium, aluminium, zinc, and manganese. When several additional acids are used, excess of one ingredient is preferable. If hydrochloric acid is employed as the conversion agent, a mixture of sulphuric and sulphurous acids is preferred as catalyst. The ligneous material is mixed with one-half to less than an equal volume of water in order to prevent formation of non-fermentable sugars. After the vapours from a preliminary steam-treatment in an autoclave have been removed, the requisite acids are introduced, the conversion acid being added in sufficient quantity to leave the treated material so that it can readily be disintegrated, and the pressure is raised to 7 or 8 atmospheres. Steam may be employed at a lower pressure by the addition of special "protective" substances, e.g., metallic oxides. On completion of the conversion process, the contents are rapidly cooled by evacuation into a cooling-chamber, where the furfural is condensed. Any furfural or methyl alcohol remaining in the residues is removed by suction or by blowing in steam. The sugar solution is obtained from the residue by lixiviation.

FILLING SUGAR MOULDS OF THE ADANT TYPE. *H. Delvenne.* of Frankenthal, Rheinpfalz, Germany. *145,526* (*16,910*). June 22nd, 1920; convention date, September 20th, 1918; *not yet accepted;* abridged as open to inspection under Section 91 of the Act.

A charging-device for filling sugar moulds of the Adant type comprises a member *6* fitted with funnels *9* alined with outlets from the vessel *1*, and adapted to register with the mould compartments *11*, the material flowing from the vessel *1* through cocks *2*, through the funnels *9* into compartments *11*. The member *6* is supported by a cylinder *4* embracing a fixed piston *3* and can be raised, for the introduction and withdrawal of the carriage *22*, by admitting pressure fluid through a passage *17* to the space *5*. Each funnel *9* is formed with a slot adapted to register with the opening *10* of a compartment *11* and is provided with a rotary valve *12* extending the length of a slot and furnished with a handle *13*. In operation, the member *6* is raised and a carriage *22* run into position; the member is then lowered and the cocks *2* and valves *21* are opened, allowing the material to drop directly into the compartments. After filling, the valves *12* and cocks *2* are closed and the member *6* again raised for the withdrawal of the carriage.

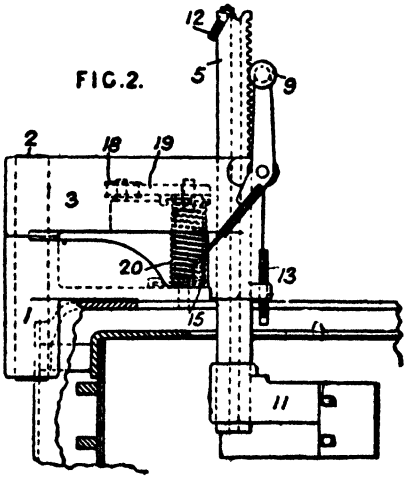
FIG.1.



DISCHARGER FOR CENTRIFUGAL MACHINE. *S. S. Hepworth Co.* (Assignees of *E. D. Mackintosh*), of New York. *143,900* (*14,550*). May 28th, 1920; convention date, September 4th, 1914; *not yet accepted;* abridged as open to inspection under Section 91 of the Act.

Solids (as sugar) are discharged from the basket of a centrifugal machine by a plough *11* carried on a non-rotatable bar *5* sliding vertically in an horizontal arm *3* supported on a spindle *2* mounted to turn in a fixed bearing *1*. The bar *5* is raised and lowered between fixed stops *12*, *13*, by a rack and pinion operated by a winch handle *9*, the plane of movement of which passes wholly to one side of the bearing *1*. A stop *15* is provided to hold the plough in its position of rest as shown. A cam *19*, urged by a spring *20*, acts against a roller *18* carried by the arm *3* to press the plough outwardly against the basket while in action.

FIG.2.



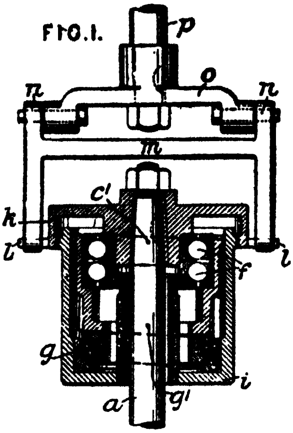
BELT GEARING. *S. S. Hepworth Co.* (Assignees of *E. D. Mackintosh*), of New York. *143,901* (*14,551*). May 28th, 1920; convention date, September 29th, 1916; *not yet accepted;* abridged as open to inspection under Section 91 of the Act.

A belt pulley is mounted on a pivoted frame and is pressed against a belt by a weight acting through a lever and toggle-links. The tension may be relieved by lifting the link, the part being retained in this position by a latch on the lever engaging between projections on the frames.

Centrifugal Machine Shafts. *S. S. Hepworth Co.* (Assignees of *E. D. Mackintosh*), of New York. *143,903* (*14,553*). May 20th, 1920; convention date, October 30th, 1918; *not yet accepted;* abridged as open to inspection under Section 91 of the Act.

The suspended shaft of a centrifugal machine is driven from a motor shaft above it through a universal joint consisting of a link *m* hinged at *n* to a head *o* on the driving-shaft *p* and engaging forks *l* secured to the driven shaft *a*. A fixed bearing-casing *i* contains a tilting plate *g* supporting a ball-bearing *f* by which the shaft is suspended. The plate *g* tilts about a centre g^1, and the shaft *a* swings about c^1. The casing *i* limits the extent of swing allowed. A flange *k* carrying the forks *l* closely surrounds the casing *i* without touching it, to exclude dust from the bearing.

FIG. 1.



Centrifugal. *Fesca & Sohn,* of Lichtenberg, Berlin. *145,397* (*979*). January 12th, 1920; convention date, June 18th, 1919; *not yet accepted; abridged as open to inspection under Section 91 of the Act.*

Coating Confectionery, etc. *E. C. R. Marks* (*National Equipment Co.*, of Springfield, Mass., U.S.A.) *140,871* (*2231*). January 29th, 1919; May 27th, 1920.

In chocolate coating-machines, in which the goods are passed from one conveyor to another while the coating is soft, means are provided independent of the conveyors and located between their adjacent ends to wipe off the "tails" which form when the goods leave the first conveyor.

Conversion of Sugars into Formic, Acetic, or Butyric Acid by Fermentation. *Soc. Darrasse Frères,* of Paris. *123,326* (*3509*). February 13th, 1918; May 13th, 1920.

Instead of utilizing the sugars present in waste products by converting them to alcohol by fermentation with yeast, aceto-butyric bacteria [1] are employed for their conversion to formic, acetic and butyric acids, the relative quantities of which will vary somewhat according to the particular kind of micro-organisms used and the conditions of incubation, e.g., the acidity or alkalinity, and the temperature.

Coating Confectionery. *Joseph Baker & Sons, Ltd.*, of Willesden Junction, London. *142,935* (*3686*). February 14th, 1919; May 14th, 1920.

Claim is made for a method of coating confectionery with chocolate or similar substance, consisting in feeding the substance in liquid consistency to a flooding vessel above the confections, cooling part of the substance in the said vessel to render it of thicker consistency, mixing the thicker and thinner parts of the substance together in said vessel, and then directly causing said mixed substance to overflow therefrom in a stream over the confections.

Production of Alcohol from Rice Straw. *A. B. C. Rogers,* of Westminister, London, and *Sir C. H. Bedford,* of Woking, Surrey. *144,079* (*13,338*). May 27th, 1919; June 10th, 1920.

Rice straw is treated with steam (which is preferably superheated), pulped, and heated with dilute hydrochloric or other acid, under pressure, if desired. About one-third of the pulp dissolves. After filtering, the liquid is neutralized and fermented.

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[1] Isolated from soil which has been manured with dung or dead leaves.

Water-Tube Boilers. *Herbert L. Williams*, of Eltham, Kent. *142,046 (28,691)*. November 19th, 1919; April 29th, 1920 (two figures).

According to this invention, there is combined with a plurality of inclined straight water tubes, headers of *V*, *W*, or serrated form, or sinuous, disposed at the front and the rear of the generator to which the inclined water-tubes are connected in groups, and a plurality of uptake and downtake tubes, each header being connected at its highest points by uptake or downtake tubes independent of those of the other headers to a common steam-and-water drum or drums. The headers are provided with cover-plates for the inspection, cleaning and withdrawal of the tubes.

Roasting Cocoa. *Louis A. Lévy and Richard Lenoir*, of Paris. *148,082 (25,691)*. October 20th, 1919; July 29th, 1920. (Two figures.)

A process of continuously roasting cocoa is claimed which is characterized by the fact that the cocoa is submitted indirectly to the action of the means of heating, and is never in contact with any part having a higher temperature than that required for roasting. As the process of roasting is completed when the temperature prevailing has first produced its effects on the beans, the heat has no further action on them. Regarding the apparatus used, this is characterized by a chamber through which passes an endless belt provided with plates to receive the beans, and agitators for the purpose of stirring the mass to be roasted, heat being indirectly applied to the beans from a source disposed within the chamber.

Centrifugal. *Guy H. Elmore*, of Swarthmore, Pa., U.S.A. *144,979 (3644)*. February 6th, 1920; June 24th, 1920. (*S*even figures.)

Claim is made for a centrifugal dryer for handling materials of a fine granular texture, e.g., crystalline salts, in which a conveyor element rotates co-axially within a rotatable annular screen, while scrapers or flights more near but out of contact with this screen, characterized by the feature that an automatic mechanism operates periodically to reduce the clearance between the screen and flights to effect a clearing of the screen.

UNITED KINGDOM COMPLETE SPECIFICATIONS ACCEPTED.

Filtering Media. *O. Baumgartner*. *151,620 (27,123)*. November 6th, 1915.

Fertilizers. *Compagnie des Phosphates de Constantine*. *151,684 (15,020)*. June 14th, 1919.

Boiling Pans. *T. O. Ward*. *151.685 (15,170)*. December 12th, 1919.

Extracting Beet. *N. T. Thaberg*. *151,907 (10,565)*. April 15th, 1920.

Food Product containing Sugar. *Merrell-Soule Co*. *151,965 (16,570)*. October 2nd, 1919.

Rectifying Columns. *Barbet & Fils & Cie*. *151,988 (27,689)*. October 1st, 1919.

Candy Making. *W. B. Laskey*. *151,940 (27,918)*. April 18th, 1917.

Refining and Chasing Machine for Chocolate Manufacturing. *J. C. Robins*. *152,109 (16,862)*. July 5th, 1919.

Lid for Syrup Tins. *J. F. Wright*. *152,188 (23,348)*. December 18th, 1919.

Mould for Chocolate Manufacturing. *A. A. Ballatore*. *152,222 (28,143)*. November 13th, 1919.

Manufacture of Alcohol and Ether. *A. A. L. J. Damiens, M. C. J. E. de Loisy, and O. J. G. Piette*. *152,495 (22,739)*. September 16th, 1919.

Manufacture of Glycerin from Sugar. *Vereinigte Chemische Werke A.-G.* *138,330 (1976)*. (Additon to *138,099*.) May 19th, 1916.

Confectionery Coating Machines. *National Equipment Co*. *152,583 (9477)*. April 1st, 1920.

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

	One Month ending October 31st.		Ten Months ending October 31st.	
	1919. Tons.	1920. Tons.	1919. Tons.	1920. Tons.
Unrefined Sugars.				
Russia	....	....	....	...
Germany	....	....	....	5,964
Netherlands	....	....	1	....
Belgium	....	....	....	....
France	....	....	....	....
Austria	....	....	....	....
Java	6,696	67,807	160,198	163,287
Philippine Islands	....	....	1,737	....
Cuba	57,934	30	484,758	506,600
Dutch Guiana	....	....	1,252	59
Hayti and San Domingo	....	....	....	14
Mexico	....	....	....	....
Peru	8,340	3,264	56,734	35,079
Brazil	1,411	4	6,227	6,163
Mauritius	6,693	3,893	121,352	106,476
British India	341	691	3,384	16,746
Straits Settlements	....	....	....	....
British West Indies, British Guiana & British Honduras	7,226	282	105,907	121,619
Other Countries	2,235	8,385	14,523	38,139
Total Raw Sugars	**90,877**	**84,356**	**956,073**	**1,000,146**
Refined Sugars.				
Russia	....	....	....	....
Germany	....	....	....	126
Netherlands	....	1	10,917	1,066
Belgium	15	1	2,635	2,114
France	....	....	23	24
Austria and Hungary	....	....	....	123
Java	2,786	1	100,930	5,011
United States of America	16,975	28	160,249	100,419
Argentine Republic	....	5	9	45
Mauritius	300	....	16,602	....
Other Countries	3,552	80	50,917	7,757
Total Refined Sugars	**23,629**	**116**	**342,282**	**116,685**
Molasses	13,395	8,268	100,513	66,101
Total Imports	**127,901**	**92,740**	**1,398,868**	**1,182,932**

EXPORTS.

	Tons.	Tons.	Tons.	Tons.
British Refined Sugars.				
Denmark	....	....	....	....
Netherlands	....	108	....	110
Portugal, Azores, and Madeira	....	4	....	4
Italy	....	....	....	....
Canada	....	....	1	....
Other Countries	122	334	1,054	1,020
	122	446	1,055	1,134
Foreign & Colonial Sugars.				
Refined and Candy	477	50	2,575	2,850
Unrefined	5,173	1,688	32,234	9,605
Various Mixed in Bond	....	....	....	....
Molasses	3,436	452	7,773	3,218
Total Exports	**9,208**	**2,636**	**43,637**	**16,807**

Weights calculated to the nearest ton.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1920. Tons.	1919. Tons.
Total Receipts January 1st to October 28th	2,635,879	2,581,196
Deliveries ,, ,,	2,624,256	2,579,196
Meltings by Refiners ,, ,,	2,360,007	2,537,000
Exports of Refined ,, ,,	325,000	400,000
Importers' Stocks, October 27th	11,623	2,000
Total Stocks, October 27th	71,311	55,686
	1919.	1918.
Total Consumption for twelve months	4,067,671	3,495,606

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1917-1918, 1918-1919, AND 1919-1920.

(Tons of 2,240 lbs.)	1917-18 Tons.	1918-19. Tons.	1919 20. Tons.
Exports	2,821,977	3,135,399	3,209,884
Stocks	388,195	590,606	311,063
	3,210,172	3,726,005	3,520,947
Local Consumption	80,700	74,000	70,700
Receipts at Ports to September 30th	3,290,872	3,800,005	3,591,647

Havana, September 30th, 1920 J. GUMA.—L. MEJER.

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR TEN MONTHS ENDING OCTOBER 31ST, 1913, 1919, 1920.

	IMPORTS.			EXPORTS (Foreign).		
	1913. Tons.	1919. Tons.	1920. Tons.	1913. Tons.	1919. Tons.	1920. Tons.
Refined	716,828	342,282	116,685	702	2,575	2,850
Raw	841,408	956,073	1,000,146	3,464	32,234	9,605
Molasses	128,438	100,513	66,101	386	7,773	3,218
	1,686,674	1,398,868	1,182,932	4,552	42,582	15,673

	HOME CONSUMPTION.		
	1913. Tons.	1919. Tons.	1920. Tons.
Refined	711,286	315,322	135,287
Refined (in Bond) in the United Kingdom	609,976	689,237	682,898
Raw	99,244	246,518	165,831
Molasses	26,499	38,013	24,824
Molasses, manufactured (in Bond) in United Kingdom	30,715	58,783	60,763
Total	1,477,720	1,347,873	1,069,603
Less Exports of British Refined	19,980	1,055	1,134
	1,457,740	1,346,818	1,068,469

Sugar Market Report.

Our last report was dated 9th September, 1920.

On the 1st instant the following alterations were announced by the Royal Commission. The price of 96s. per cwt. duty-paid was fixed alike for Granulated, Crushed and White Pieces for domestic consumption and as the reasonable maximum for "Free sugars." As from the 15th instant the retail price for both categories will be 1s. per pound. After a temporary reduction to 8 ounces, as a precautionary measure in view of the coal strike, the weekly ration of 12 ounces per head has been reinstated. West India sugars are now subject to no restriction other than that of the maximum price.

In anticipation of a reduction, the home market had continued in a dull state, with the trade disinclined to buy, and even unwilling to take up their full allotments. It is still necessary to offer some concession on the maximum price to effect sales of "free sugar." Limited quantities of white descriptions are being traded at about 95s. to 96s., while best qualities of West India Crystallized are obtainable at 82s. to 83s. per cwt., spot terms duty-paid. For Muscovados there is no demand, buyers apparently being fully stocked with raw sugars.

The final outturn of the Cuban crop 1919-20 is stated by Messrs. GUMA & MEJER, Havana, to be 3,730,077 tons as compared with 3,971,776 tons for 1918-19, and 3,446,083 tons for 1917-18.

A persistent and considerable fall has taken place since our last report, but the mere comparison of present values with those ruling at that time, does not show the tribulation suffered in the meantime by the sugar world in general and the two greatest producing countries in particular. Early in October it was evident that the handling of the balance of the Cuban crop had become so deeply involved with questions of finance as to bring matters to an acute stage, affecting not only holders of sugar and the banks financing them, but the Cuban banking community as a whole. A moratorium was proclaimed on the 11th October to be in force until 1st December, and certain American bankers in conjunction with refiners arranged an advance to the Cuban Government for the purpose of aiding the bankers and sugar interests of the island. To-day the quotation for Centrifugals stands at 6·50 cents f.o.b., so that the season has provided the spectacle of a rise to the neighbourhood of 23 cents and a subsidence to the original starting point. If the cost of production is, as it is stated to be, between 4 and 5 cents, there is reason to hope that the efforts being made will tend to steady the market.

Financial difficulties being, unfortunately, common to all countries, the sugar position in Cuba could not fail to have far-reaching effects and add to trouble where trouble already existed. In Java heavy speculative commitments proved unmanageable in a constantly falling market, and led to a debacle in price and failure of some speculative holders to meet important obligations for October delivery, necessitating the study of ways and means to tide over the difficulties. It is to be expected that every effort will be made to stabilize values by nursing the stocks in distress, a process which can only be rewarded by measurable success when confidence is sufficiently restored to translate potential requirement into actual demand. White Javas have been quoted for near delivery at 30 guilders per picul f.o.b. (say about 45s. per cwt.), a fall of over 20 guilders in the period under review; but latest advices report a steadier market, with business done at 31 guilders.

In America it is estimated that the apparent consumption to end of September exceeded that in the same period of last year by no more than about 150,000 tons, but with a falling off in exports of roughly 100,000 tons, the disappearance would seem to be only about 50,000 tons in excess of last year. The supplies available from Cuba, Porto Rico, Hawaii and various sources, added to the domestic beet and Louisiana crops, should be sufficient to cover any increase of consumption likely to be shown between now and the end of the year, besides providing an adequate stock to carry into next year.

In Europe the Beet crops generally benefitted by the fine weather of the late autumn, but final outturns depend largely upon labour, fuel, etc., conditions. Italy, Greece and Roumania are still desirous of buying, and although White Javas for the Mediterranean are available in good quantity, business is not easy to negotiate, owing to difficulties in providing credits.

Broadly speaking, in the present unsettled state of affairs, it is useless to attempt to gauge the position by statistics, and almost impossible to form an opinion as to the trend of the market in the near future.

H. H. HANCOCK & Co.

10 & 11, Mincing Lane,
London, E.C. 3,
6th November, 1920.

THE
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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

Notes and Comments.

The Question of De-Control in the United Kingdom.

The general press for some weeks past has been prophesying the early termination of the sugar control in the United Kingdom. This, following on the abolition at the end of November of the sugar ration and the reduction in the price of sugar to 10d. for granulated, would be the final step in freeing the sugar market from official control, except as regards the maintenance of maximum retail prices. But it is not at all probable that the de-control will be effected just yet, though the final decision remains in abeyance while the Government have the matter under consideration. In any event they will have to come to an early decision one way or other, since if control is to continue longer, the Royal Commission will need to take steps to secure a share of the new Cuban crop, while in the reverse case the market will require notice to enable them to commence operations on their own. But while in some quarters an early termination of the Royal Commission's operations would be welcomed, it should be observed that opinion in favour of that step is largely political: the trade, the refiners, and the brokers are understood to be by no means hankering to have the transfer effected in practically the middle of the sugar season. They would prefer the change to take place at the end of the present "campaign," that is next August or September. As it is understood that the Ministry of Food does not intend to close down finally for another 12 months or so, there would be little difficulty in continuing control of sugar till next Autumn. Dealers after having been out of a free market for six years are not keen on being thrown on their own resources at this stage; there are still risks to be encountered in the present unsettled condition of the world's sugar market, and till there is some nearer correlation between supply and possible demand, there is much to be said from even the consumers's point of view for exercising some further control over the sugar supply in this country.

Supplies, however, have been more plentiful of late, and the Royal Commission have pursued their task of picking up parcels of sugar at more moderate prices. Peruvians and Brazilian sugars have been bought lately in fair amount, but we question whether as rumoured in the market press any of the late crop Cubas have been bought by the Commission just recently. Nor is it as yet confirmed that 50,000 tons of German sugars have been secured. This latter sugar is more likely to be Czecho-Slovakian sugar exported viâ German ports. But it is said to be the fact that the German Government are authorizing the export of certain quantities of sugar in return for certain imports of raw cane which would help to keep their refineries going.

At the end of November, as we said above, the rationing of sugar ceased in the United Kingdom, and the control prices were reduced to allow granulated to be sold at 10d. and cubes at 10¾d. per lb. With the de-rationing, the public are free once more to buy white sugar of any description *ad lib.* from any retailer, and one of the most irksome of the minor restrictions of the war for the middle and upper classes of the community has been dropped. No great per capita increase in consumption is, however, to be looked for, since money is no longer plentiful, and the family budget of the average working class household will not stand any large purchase of sugar at present prices of food generally.

Willett & Gray's Estimates of the 1920-21 Crops.

On another page we give Messrs. WILLETT & GRAY's first forecast of the sugar crops of the 1920-21 season throughout the world, a forecast they customarily issue about this time of the year. Admittedly, as they are careful to point out, this is an indication rather than an estimate, since reports so far are only partial and are necessarily subject to revision, especially if the next two or three months of growing weather that remains in many instances materially affects the prospective yield of cane.

Subject to this, they assume for the moment that the total of cane and beet for the year in question may attain to 17,085,500 long tons, or an increase of 1,774,676 tons as compared with the season just closed, and one of 1,147,521 long tons in excess of the 1918-19 season. This total, we observe, is made up of 12,580,500 tons of cane and 4,505,000 tons of beet. Increases are mostly distributed in small amounts all over the sugar-growing regions, a few thousand extra tons here or there being the rule; but some of these are merely increases over a deficient crop last season rather than any average increase on past years. The few outstanding crops of cane which promise marked increases are *Brazil*, which hopes for 300,000 tons as compared with 177,155 tons in 1919-20; *Java*, 1,515,000 tons, as compared with 1,335,763 tons in 1919-20 (but with 1,749,408 tons in 1918-19); *Formosa* and *Japan*, 350,000 tons, compared with 283,482 tons in 1919-20 and 415,678 tons in 1918-19; *Mozambique*, 40,000 tons as compared with 35,000 tons last season (here the 1918-19 production is to be virtually doubled if all be well): otherwise the cane sugar crops individually call for no comment—the British West Indian and British Guianan total is only increased by some 4000 tons (286,500 as compared with 282,518 tons).

The beet crop estimate is not new since it relates to the sowings effected six months ago. But the latest estimate by Messrs. WILLETT & GRAY places the total for the current campaign, including the United States and Canada, at 4,505,000 tons as compared with 3,358,528 tons in 1919-20. In America the indigenous beet crop is expected to reach 950,000 tons as compared with 652,957 tons last year, and Canada promises a jump from 16,500 tons to 35,000 tons. As for the European total, which is placed at 3,520,000 long tons by Messrs. WILLETT & GRAY, we need only observe that it is slightly higher than the figures supplied us by our Continental correspondent which we published last month; the latter gave the probable total as 3,572,000 metric tons, which is roughly equal to 3,500,560 long tons. But as our correspondent eliminated Russia, Switzerland, Rumania and Bulgaria as doubtful, the totals in the two estimates approximate very closely.

The Cuban crop Messrs. WILLETT & GRAY are content for the present to put down at 4,000,000 long tons. The weather has been favourable on the whole and increased plantings are reported, though so far precise data are lacking. But there are ten or twelve new factories either complete or in course of construction that may add to last year's outturn, while many of the old plants have increased their capacity with more efficient machinery, and this will naturally tend to increased production. The present indications are therefore in favour of a somewhat increased crop outturn as compared with last year.

The Financial Crisis in Cuba.

Private advices from Cuba only serve to emphasize the fact that the crisis in the sugar industry in Cuba, which culminated in the institution of a moratorium that has not yet been lifted, was largely due to the operations of unscrupulous speculators, amongst whom it is hinted were found a number of banking officials. The temptation to speculate in sugar was too strong for the Cuban commercial community in general, and all classes invested in that commodity in the firm belief that Cuba held the sugar world in its hands and could not be undersold. Stockbrokers, merchants, farmers, and others all had a finger in the speculative pie and in some cases started to buy sugar at 18 cents in the belief that the price would be forced up before long to 25 or 30 cents. Actually the price attained 22½ cents for a few hours, but opinion was maintained that it would rise further and that the 25-cent mark would soon be reached. Instead, the pendulum began to swing back for good, and in a few days was below 19 cents and then below the 16-cent mark. The speculators hung on to their sugar till it was too late; the natural consequence is they are now faced with heavy losses if not ruin. But we think precious little sympathy will be wasted on them either by the consumer whom they tried to bleed or by the bonâ fide producer who in many cases has profited all too little from the rise in prices because he contracted at a more moderate figure long before the speculative rise took place.

Some good may come out of it all if the Cuban sugar interests once so heavily bitten are more chary in future about trying to corner the market in so world-wide a production. After all, the industry in Cuba still exists and the crisis beyond sobering it will not greatly impede its future output of sugar. All commitments for the coming crop are already made we understand, the canes will grow moratorium or no moratorium, and the coming crop season will result much as before in the production of some three or four million tons of sugar. A few new plantations, it is true, which started operations on a high price basis will probably not be able to go on under the changed conditions without reorganization or transfer of ownership; but it is hardly likely that their mills will be allowed to remain idle.

A New Weekly Digest of Sugar News.

Mr. TRUMAN G. PALMER, the indefatigable secretary of the United States Sugar Manufacturers' Association, Washington, has not rested content with his efforts to record the statistics of the world's sugar industry, as shown in his Loose Leaf Service "Concerning Sugar." He has just started a *Sugar Bulletin* with the object of furnishing a weekly digest of all the important sugar news of the day "in such manner as to save time for the busy man who wishes to keep in touch with certain angles of the sugar industry but finds it burdensome or impossible to pursue at length all of the many publications in which such news appears." Of such a class of readers, it is claimed by Mr. PALMER that rather than peruse many uninteresting pages of news they "subscribe to but a portion of the sugar journals, thus losing the news value of the balance." For such students Mr. Palmer's *Sugar Bulletin* is designed. It consists of a very brief digest of articles that have appeared, classified under such headings as "Commercial," "Statistical," "Technical," "Agricultural," etc., and mention is made of the source of the original paper and its approximate length in words. For this Bulletin the charge to subscribers is fixed at $15.00 per annum (binder included), and applications should be made to Mr. PALMER at 901, Union Trust Building, Washington.

We do not think the difficulty which Mr. PALMER premises and seeks to overcome applies as much to our journal as to others of his own country which, in seeking to give all the news, necessarily crowd their pages with a variety of information that in the absence of a very detailed annual index is somewhat difficult to assimilate. Much that we give is a concise summary of very long papers in other publications that the busy man may indeed have no time to wade through, especially if he does not know the foreign language in which the original may be written. Apart from that, we make a speciality of a detailed annual Index (as witness that included in the present number) which is bound to assist greatly those searchers after "certain angles of the sugar industry." But this said, we are disposed to welcome Mr. Palmer's new production since, we think, it will inevitably tend to increase the regular perusal of those sugar publications which are found to contain much that interests a particular student of sugar affairs. It may also assist some busy men in ascertaining quickly the existence of their pet subjects in papers that are at least taken by their firm, while it should also help to arouse interest in sugar subjects amongst a widespread class who do not usually know where to seek for suitable organs of technical literature.

Sugar Growing in Peru.

A paper read recently before the American Chemical Society, by CHARLES A. GAMBLE, on the sugar industry in Peru, merits a brief summary in our pages. Peru's sugar is grown in a number of narrow but very fertile coastal valleys which are watered by irrigation, under Government control, the water being derived from rivers flowing from the mountainous interior. This irrigation is the sole source of water for the Peruvian cane fields, since rain never falls on the coastal regions of Peru; the western trade winds from the Pacific encounter a cold current sweeping northward off the coast and are there divested of their moisture, while the high Andes similarly divest the Atlantic trade winds of theirs. But thanks to the irrigation practised, all varieties of cane thrive and develop equally well and heavy crops of cane are reaped. Three causes are believed to contribute to this: the even temperature, the control of moisture, and the intensive use of guano. Labour for both field and factory is plentiful and cheap. Fields grow successive crops of cane for six to eight years, after which they are deep ploughed, fertilized with about three tons of guano per acre, and then replanted with cuttings which take about 22 months to mature. After the cane has been cut, the field is irrigated thoroughly, whereupon the ratoons immediately commence their new growth, maturing in some 18 months.

The cane is of good quality both in sucrose content and tonnage. It is quite common for it to average 50 tons per acre, and 40 tons is considered very ordinary. The cane will average 15 to 16 per cent. sucrose in cane for the crop and show a purity of 85 to 88. The glucose is comparatively low, averaging 3 to 5 per cent.

The factories of Peru are usually of a capacity of 200 to 400 tons per 24 hours, though there are a few that can deal with from 1200 to 1400 tons per day. Some of the factories are modern and up-to-date in every respect, but most of the smaller ones are still using very old machinery and antiquated methods of sugar manufacture. The juice from the mills is as a rule first sulphured, then limed, so that 10 c.c. of juice will require about 1 c.c. of N/10 alkali to neutralize, using phenolphthalein, after which method of clarification the ordinary procedure follows. The resulting sugar is washed thoroughly in the centrifugals and dried by steam, an off-colour white (having a polarization of 99·3 to 99·5) being thus obtained. This is the only white sugar seen in the better class homes and cafés of Peru. Most Peruvian whites are of fair colour, but are specky and contain some foreign particles probably derived from the heating apparatus in which the juices and massecuites are treated. The molasses is boiled to lower sugars having polarizations from 96° to 99°.

Mention should not be omitted of the alcohol production derived from the low purity molasses, a grade of 80 to 85 per cent. alcohol being obtained. For a factory grinding 400 tons of cane per diem, the alcohol obtained from the waste molasses amounts to 300,000 litres for the grinding season. This alcohol, called "ron," sells for 16 Peruvian cents. (say 4d.) per litre (0·22 gallons) and it is stated that one of the largest and most up-to-date factories in Peru paid all its factory expenses from the sale of the "ron," so that all the sugar made represented clear profit.

The Motor Tractor Trials at Lincoln, 1920.

On another page, we reproduce (slightly abridged) an interesting paper that appeared in the *Journal of the Ministry of Agriculture*, from the pens of three expert observers of the tractor trials at Lincoln last September. These trials would appear to be, at any rate for the present, an annual feature and they attract a large amount of attention from the farming community in this country. The paper is in the nature of a thoughtful criticism not only of the types of machine entered for the contest, but also of the conditions under which the contest was held by the Royal Agricultural Society. Our readers will be primarily interested in the machines themselves and their performances (a final review on which has yet to be issued by the authorities). But the criticisms and suggestions embodied in this paper are of such a character that they are bound to be an aid to all those who are seeking a satisfactory form of motive power to replace the animal traction still predominating in the cane fields. We therefore make no excuse for giving this paper in rather full detail. We believe it will be studied with considerable interest by all our readers who are concerned with the agricultural side of the industry.

The 1921 Trinidad Crop.

The prospects of the coming Trinidad sugar crop, according to Messrs. TRIPP & Co., may on the whole be regarded favourably, and given ordinary fair conditions an output of some 60,000 tons may be looked for. There has been the usual outbreak of froghoppers, whose appearance however at a later time of the year than previously (when the further maturity of the cane renders it less susceptible to attack) is not expected to have as serious results as on former occasions. But unfortunately there has been an outbreak of the Mosaic disease, which has been apparently brought into the island by means of imported canes. Strenuous efforts are being adopted by the Department of Agriculture to exterminate this new pest before its ravages extend, and it is hoped that the measures adopted will be successful.

Sugar Cane Agriculture in Jamaica, 1919-20.

The annual report of the Jamaica Department of Agriculture for the year ending March, 1920, as prepared by Mr. H. H. COUSINS, the Director of Agriculture states that "sugar has made marked progress with an export of 38,000 tons valued at one and one-third millions sterling, while the rum crop raised the total exports of the sugar industry for 1919 to a total of two and one-quarter million pounds in value. This record is expected to be exceeded by a wide margin in the current year and the high prices now resulting from the world shortage of sugar are reacting strongly on the sugar industry of the island which is now rapidly being developed to a standard of 100,000 tons per annum."

At the Experiment Station over 10 acres were replanted with cane during the year under review. The number of tops and cuttings distributed amounted to 110,089. They now have over 5 acres of Uba cane, a variety which is doing well and is resistant to disease. In February, 1920, the existence of Mosaic disease was discovered and measures were immediately taken to combat it. All diseased canes were cut down and the tops of healthy canes only were planted. By this method it is hoped soon to rid the fields of the disease. B. 208 is the cane most affected by it; the Demerara varieties and the White Tranparent are highly resistant, while the Uba is immune.

In sugar cane work, the Department of Agricultural Experiments made a survey of the island to ascertain the extent of the Mosaic disease and the amount of damage that it is doing. The investigations showed that the effects varied greatly; in Trelawny and Westmoreland Parishes there were instances of fields where from 50 to 100 per cent. of the canes were affected; but generally speaking the usual infection where it existed was less than 1 per cent. of the cane. Official opinion is that the amount of disease prevalent is too small to make it difficult to control and eventually eradicate it.

In some varietal experiments, on a field scale, some canes of the D. 116 variety were tested and found to give a tonnage of 49½ tons cane per acre. The analysis of the cane gave: juice per cent., 88·60; fibre per cent., 11·40; sucrose per cent., 13·02; while the juice had a purity of 84·61 and a glucose percentage of 1·17. Under average working conditions in Jamaica this would imply a return of 4 tons of sugar and a puncheon of rum per acre.

A test was also made between Uba canes and Estate canes of the Ribbon and White Transparent varieties. The Uba yielded 26·8 tons per acre and the Estate cane 35·5 tons. The analysis of the juice was found to be: UBA—Brix (corr.), 20·85; sucrose per cent., 17·38; purity, 83·37; glucose per cent., 1·01: ESTATE CANE—Brix (corr.), 19·85; sucrose per cent, 17·84; purity, 89·88; glucose per cent., 0·88.

The Chancellor of the Exchequer recently stated in the House of Commons: "It is necessary both for the protection of the revenue (having regard to the high rates of duty on spirits at present in force in this country), and in fairness to home manufacturers, that all spirits intended to be used as motor fuel should be denatured here under the supervision of the revenue officers in a manner approved by the commissioners of Customs and Excise. The importation, duty free, of "Natalite," or any other spirit denatured abroad, would involve risks to the revenue which, as at present advised, I am not prepared to take."

The Department of Brewing and Biochemistry at Birmingham University is now provided with well-equipped laboratories for training students in the fermentation industries, sugar technology, foods and drugs, and applied bacteriology. On the occasion of the recent opening of the term, an inaugural lecture was delivered by Prof A. R. LING, F.I.C., the principal of this department, who said that last session had been a record, so far as numbers were concerned, and that in the session now opened the attendance of students was even greater.

Royal Commission for the Sugar Supply.

Recent Announcements and Prices.

The Food Controller announced at the end of November that from Nov. 29th the individual rationing of sugar in the United Kingdom would be discontinued, and the Sugar Rationing Order, 1920, was revoked from that date. With this revocation the era of individual rationing was brought to an end, and for the first time since December 31st, 1917, members of the public were able once more to purchase any article of food without the production of a ration document. In the case of sugar it, of course, meant that the public were once more free to purchase from any retailer, without restriction as to quantity, such supplies of white sugar as might be available. The only exception to the free distribution of sugar is that the voucher system of distribution of white sugar through the trade remains in force.

The following is the complete list of revised sugar prices from November 29th till further notice:—

	Wholesale per cwt Discount 1¼ per cent. to direct buyers	Approved retail price, per lb.
0. Castor, Icing, Pulverized	86s.	10¾d.
1. Cubes, Loaf Sugar	84s.	10½d.
2. Granulated, Crystals, Crushed and Chips, Dry White Sugar, White Pieces (moist)	80s.	10d.
3. W I. Grocery Crystallized Yellow Crystals, W. I. Muscovado (moist), Pieces (other than White), W. I. Grocery Syrups	Price must not exceed that fixed for Licenced Free Sugar.	
4. Jellies, Knots, Lumps, and other Low Grade Sugar to be sold only to manufacturers	Uncontrolled.	

The wholesale prices quoted are those at which sugar will be supplied to direct purchasers by the Commission or by refiners.

Wholesale dealers through whose hands sugar passes are entitled to the authorized margin of profit on the net cost, and to charge the actual cost of carriage. In addition, certain other charges are allowed for handling and storing; and for breaking bulk where the quantity to be delivered is less than that contained in the original package.

Licenced "Free" Sugar.—The maximum "reasonable" price for all licenced "free" sugar from 29th November until further notice has been fixed at:—

Wholesale per cwt., discount 1¼ per cent.	80s.
Retail, per lb.	10d.

Syrup and Molasses will be sold by refiners at prices approved by the Commission.

Vouchers for period 13, commencing 29th November, 1920, and until further notice, may be fulfilled at the following maximum rates:—

Colour.	Per cent of face value.
White	200
Blue-green (ships stores)	100
Blue (general manufacturers)	400
Brown (wholesale jam manufacturers)	500
Pink (mineral water manufacturers)	300

Guma & Mejer's final figures of the 1919-20 Cuban sugar crop shows that 192 centrals worked and produced 28,110.540 sacks, equivalent to 3,730,077 long tons. Central Morón in the Jucaro district came first with 87,290 tons, followed by Delicias with 82,677 tons, Cunagua with 79,017 tons, Boston with 68,525 tons, and Espana with 66,220 tons. Central Chaparra comes rather low down in the big results this year, having produced only 60,125 tons instead of the 71,429 tons (500,000 sacks) estimated.

Fifty Years Ago.

From the "Sugar Cane," December, 1870.

In this issue of our predecessor, a description was given of the process patented by AUGUSTE SEYFERTH,[1] for the decolorization of syrups during boiling by means of sulphurous acid, a *modus operandi* that was largely followed in the manufacture and refining of sugar on the Continent for a time. It would appear from the perusal of this article that the purpose Dr. SEYFERTH had in mind (at first at any rate) was the neutralization of the alkalis remaining in the juice or syrup after carbonatation, for which purpose sulphuric, phosphoric, and other acids had been tried, but found wanting, owing to the fact that it had never been possible "to prevent the injurious effect of even a very slight excess upon the sugar itself; while, moreover, a difficulty is encountered by the very variable quantity of alkali present, whereby the proper quantity of acid to be applied varied every moment, thus rendering their application totally unsuited in any but very skilled hands . . ."

Seyferth's patent related to "a process of purifying sugar solutions by treating them in the vacuum pan with dilute sulphurous acid, or with sulphurous acid gas, the excess of acid being eliminated during the ordinary concentration process." In practice, it was found preferable to use the solution rather than the gas, and to draw it into the pan, the boiler taking care to test the contents of the pan by means of litmus. This was done to ensure the strike remaining just alkaline; and if it were found to be acid, the remedy suggested was to draw in more syrup immediately. As advantages of this procedure, he claimed that it improved both the quality and the quantity of the sugar; that it was economical; that it necessitated little extra plant (the sulphur oven); and that it was simple, and easily learnt.

However, in this same number of the *Sugar Cane*, there appeared a letter from F. CRACE CALVERT, of the Royal Institution, Manchester, in which he stated that he had used sulphurous acid for the bleaching of syrups as far back as 1850, and that he had sold a process operating this principle to a firm of sugar refiners. In the year 1858 he had pointed out[2] that when properly applied, sulphurous acid tended to prevent the re-coloration of the liquors during boiling in the pan. Successful results, it was stated, had been obtained by adding two gallons of a saturated solution of sulphurous acid to 100 gallons of decolorized liquor as it left the char-filter *en route* for the pan supply tanks.

ALFRED FRYER continued his article entitled "The Use of Lime"; but, whereas in the previous instalment of his contribution the object was to instruct users of the "concretor" in regard to the liming of their juices previous to heating, the purpose of his later experiments described in this issue is not so clear. He concluded at any rate that "acid whether in large or small amount . . . . always produces uncrystallizable sugar . . . . and that mineral acids do more mischief than organic ones."

Lastly, it may be mentioned that an abstract was published of the specification of a patent taken out by H. B. PRESTON[3] (on behalf of J. GUARDIOLA) for a method of making concrete in which "the juice is run from the cane mill to the evaporator, and on its way receives an addition of superphosphate of lime or milk-of-lime, the impurities thrown up by the heat being skimmed by a strainer guard." The evaporator consisted of a helical gutter heated by a suitable furnace.

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[1] English patent, 2756 of 1869.

[2] *Chemist*, 1858, 5, 344,

[3] English patent, 923 of 1870.

Continental Beet Sugar Notes.

The End of the Sugar Distribution by Government Departments.

The general sugar scarcity that has been experienced in every European country as a consequence of the greatly decreased production during and after the war, compelled most Governments to take steps in order to guarantee at least an even ration of sugar for each inhabitant. Every country made its own regulations as to the extent of the weekly ration and the price to be paid for the sugar, with the result, that at no single period was there any actual lack of sugar and nobody could hoard up the desired article at the expense of his fellow-countrymen. Although the system worked well enough, every party longed for the day when circumstances would permit its abolition. It is now evident that the day has come for several of the large sugar-consuming continental countries.

FRANCE led the way by abolishing the sugar distribution on September 1st. Only a very few categories of consumers, viz., infants and people over 70 years, had still been entitled, for a few weeks, to a monthly pro capita ration of one kg.; everybody else had to buy his sugar at the shops without coupon, at a price fixed by the ordinary course of supply and demand. Although France had in the year 1919-20 only produced 155,000 tons of sugar and consumed 823,700 tons, it had purchased so much from abroad that at the end of the campaign, on August 31st, the country still disposed of a stock in the bonded warehouses of 62,137 tons, not counting the invisible stocks which had been accumulated during the last months of the financial year. With a certain stock in hand and sure of a good home crop and an ample supply from abroad, the French Government felt that it could safely set sugar free. Competition among holders would prevent the price rising too much above the then prevailing figure. The result has completely justified the step taken. Before the end of the distribution, sugar on coupon fetched 15 francs per kg., retail, and free sugar 5·50 francs, while at the present day the article is to be obtained in unlimited quantities at the price of 3·75 francs for refined and 2·75 francs for granulated sugar.

In BELGIUM the consumer was previously entitled to a monthly ration of 800 grms. at the price of 2 francs per kg. This distribution ceased in November, so that sugar can now be purchased in Belgium for home use in unlimited quantity. The price remains, however, still fixed by Government in the following way. All raw sugar and granulated from the sugar factories is purchased by Government at the price of 172 francs per 100 kg. of raws, basis 88 rendement, and at 145 francs per 100 kg. of after-products, basis 75 rendement, every degree above and under the basis to be counted at 1·70 franc. The price of granulated is 192 francs per 100 kg. This price is increased by a consumption duty of 20 francs per 100 kg. and an additional duty of 6 francs for the warehousing and handling of raw and refined during the interval between purchase and consumption.

Further, a profit is calculated for the middlemen, so that the price for the public is composed as follows:—*Granulated.*—Price to be paid to the sugar manufacturer 192 francs, duty 20 francs, additional duty and retailing expenses 28 francs, total 240 francs per 100 kg. wholesale, or 2·50 per kg. retail. *Cubes.*—Price to be paid to the refiner 240 francs, duty 20 francs, additional duty and retailing expenses 29·50 francs, in all wholesale 290 francs per 100 kg., or 3 francs retail. The raw sugar is sent exclusively to the refineries, while the granulated and the refined may be purchased quite free in the interior for use in the country. Exportation is reserved for the Government Sugar Bureau at the profit of the Government.

Belgium consumed during the past year 136,000 tons of sugar; it possessed a stock of 19,495 tons at the beginning of the campaign, and its 1920-21 crop is estimated at 225,000 tons; the country therefore disposes of sufficient sugar for an unlimited home consumption. The retail price has gone up from 2 to 2·50 francs per kg., but otherwise no untoward effects have arisen from the freeing of the sugar trade and the abolition of distribution.

In HOLLAND the Government in 1919-20 made an agreement with the sugar manufacturers, under which the latter put at their disposal 91,000 tons of refined sugar at the price of 54·25 guilders per 100 kg. (*inclusive* of duty). This sugar was distributed among retailers, who were allowed to sell it against a coupon and an amount of 60 guilder cents per kg. The total quantity was calculated so as to allow each inhabitant a sugar ration of 250 grms. per week. Further, the manufacturers bound themselves to put at the disposal of the public at a price, to be fixed monthly by Government, so much sugar as was necessary to supply all reasonable requirements. The surplus was allowed to be exported under the auspices of the official exportation bureau at a remuneration dependent on the profit.

The price of the coupon sugar—60 cents—was far below the cost of production, but the loss was made good by the profit on the sale of the free sugar which could be purchased in unlimited quantities, and on the exportation. The cost of production was calculated at 73 guilders per 100 kg., the free sugar was sold at 94 guilders, and the world's parity or the price for exported sugar was at the time 110 guilders, so that the coupon sugar could be sold wholesale at 54·25 guilders and the loss made up by the other sales. This went very well, so long as the world's price was so high as to allow a good profit on the exports and on the free sugar; but since the price of sugar in the open market has dropped considerably, the profits have decreased and have been insufficient to cover the deficit on the coupon sugar.

On October 1st, 1920, the price of the coupon sugar was raised to 70 cents per kg., while that on the free sugar remained at 94 guilders per 100 kg. wholesale. Starting, however, with November 28th, the sugar distribution was abolished in Holland, too. The sugar manufacturers now offer unlimited quantities of refined sugar at the price of 80 guilders without and 81 guilders with sack. Everybody is free to purchase as much sugar as he likes at that uniform price. Exportation is still subject to Government control and pays an export duty, which at the present price is only nominal, but may be worth something as soon as the world's price exceeds 64 guilders per 100 kg. (*exclusive* of the duty of 27 guilders).

Thus, in these three continental countries the use of sugar is free once more, while in Czecho-Slovakia the monthly ration has been extended to 1¼ kg. or 2¾ lbs. The inhabitants of that country have never before consumed so much per head, so that the sugar consumption is practically free, and only the hoarding by speculators is prevented. The price of the sugar for ordinary use in that country has been fixed at 700 crowns per 100 kg. wholesale for refined, or 7·90 crowns per kg. retail. The price of raw sugar (*exclusive* of duty) is fixed at 400 crowns per 100 kg. Refined sugar for confectionery pays 1000 crowns per 100 kg., with an additional luxury duty for sweets, candies, and the like.

It is reported in Jamaica that the Government have not secured the necessary guarantees from the cane farmers to ensure the success of the proposed 10,000 ton sugar central in St. Thomas district. If this proves to be the case, then, it is possible the scheme may be postponed till the matter has been further investigated and the commercial possibilities of the undertaking assured.

The Root Disease of the Sugar Cane.

In a recent number of this Journal[1] a preliminary sketch was made of the scientific study of the sugar cane being carried out in Porto Rico, using as a text the Annual Report of the Insular Experiment Station for 1917-18. The larger part of this report was taken up by a dispassionate review of the work of the station from its inception until the middle of 1917. In discussing the range of studies thus presented it was pointed out that, while an amazing amount of time had been devoted to the study of the various insect pests found in the cane fields, the mycological work was disappointing, and that, although it was recognized that root disease and yellow stripe or mosaic disease were dominating the industry, no reference was made to work being done on either of these during the period covered by the annual report. Further, the agricultural investigations since the foundation of the station were of a very scrappy nature, while the chemical work might be almost called negligible. In making these comments it was suggested that improvement in the treatment of the land, admittedly inadequate, should receive more attention. The following quotation summarizes the point of view expressed by the writer: "Attention has of late years been drawn in various directions to the necessity of some general agricultural training in officers investigating plant pests and diseases. This would appear to be a truism when we recall that the neglected, half-starved plants in a garden in the tropics soon become the home of all the coccidae of the neighbourhood, just as the weaker members of the herd when turned out to pasture seem to collect all the ticks. Anything tending to lessen vitality or general health will naturally cause a sugar cane plant to succumb more readily to all the pests and diseases around it. Stress of weather, insufficient water or drainage, soil that is naturally poor or overcropped, lack of rotation or fallowing, insufficiency of humus and the consequent lessening of the numbers of useful bacteria, general lack of good tilth, and a hundred other factors of importance in good cultivation, will readily occur to those versed in tropical agriculture as likely to render the plants unhealthy."

Since this was written, a number of papers have come to hand showing that the mycological side is being actively prosecuted in Porto Rico, and it is with special approval that we have recently read a paper by F. S. EARLE,[2] in which he deals with the all-important "root disease" of the sugar cane. In his conclusions he boldly attacks the deficient methods of agricultural practice in the island, and points to them as probably the main reason for the prevalence of this disease. But there is another point in Earle's paper of interest to the writer of this article. The current theory that root disease in the sugar cane is due to the attacks of a mushroom, *Marasmius sacchari*, has never fully commended itself to him, although, not being a professional mycologist and being otherwise very fully employed, this dictum has been perforce accepted by him, at any rate for the West Indian variety of the disease. When visiting the West Indies in 1893, a plant was pointed out as being typical of an attack of root disease, and this plant was laboriously examined under the microscope in order fully to grasp the nature of the attack; sections were made through every part and especially the root system without finding a trace of hostile organism; the plant appeared to be poorly grown and suffering from malnutrition, although there was no apparent cause for this; all its energies were taken up in the formation of an unnecessary number of small shoots and aërial roots, but there was not the smallest trace of any fungus hyphae in the living parts. A dozen years later, in India, plants of a similar nature were not infrequently met with in the cane fields, and in one case a whole field was seen which presented all the appearance of a virulent attack of sereh: but when carefully examined under the microscope the tissues showed no foreign element, and the significant red marks in the vascular bundles taken to be characteristic of sereh were entirely absent. Exactly similar cases were afterwards met with in many other cultivated and wild plants in India, and the general conclusion arrived at was that these were suffering from some deficiency below ground rather than an attack by specific parasite. In one case the cause of the trouble was clearly traceable to canes being too near a well of salt water used in irrigating them, in many others to their being planted in swampy pieces of land, and so on. It is then with special interest that the writer notes that EARLE, as the result of his researches in Porto Rico, discards completely Marasmius as the cause of root disease in that island, and puts the blame on a number of separate contributing factors which, by lowering the vitality of the plant, open the door to a host of facultative parasites, that is, such as cannot attack healthy, vigorously growing tissues, but soon invade those of weakly plants. It is true that in this study he has come across a true parasite of unusual character, but its full meaning in the complex has not yet been fully worked out, and he evidently gives great weight to the combined effect of the many saprophytes or feeble parasites which have been found in the various tissues involved. Since parasites of this nature can usually be rendered more or less harmless by improving the growth conditions of crops, EARLE recommends (1) the introduction of resistant varieties, (2) better cultural methods and (3) proper selection and treatment of seed cane.

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[1] *I S J*, 1920, p. 73.

[2] F. S. EARLE, Sugar Cane Root Disease. *Journal of the Department of Agriculture of Porto Rico*, iv, 1, Jan. 1920.

Diseases of a similar nature to, if not identical with, the one dealt with there are met with in the cane fields in every part of the tropics, and it would therefore appear desirable that Earle's point of view should be widely known. The following résumé of this somewhat difficult and intricate paper is accordingly presented to the readers of the *International Sugar Journal*.

So much attention has recently been devoted in Porto Rico to the mosaic disease of the canes, that the much more important root disease appears to have been rather overlooked. There is not a field in the island which is not affected by it and, but for its presence, there is no reason why 20-30 years' ratoons should not be grown, as was done in the early days of the industry. The problem is at the present moment by far the most important, not only in the island but in all tropical sugar growing countries. Unfortunately it is a very complex one. Probably there is not a plant disease of equal importance about which so little is really known and about which such a mass of errors has crept into the literature.

The symptoms are well known but difficult to describe, and form a regular sequence as the disease increases in intensity. The early stages are exactly like those of plants suffering from malnutrition, severe drought after heavy rains or insufficient drainage. If drought continues, the leaves tend to roll up in the middle of the day and, later on, the leaves die prematurely and, instead of falling normally, remain firmly fixed to the stem. The old sheaths become covered by a white matted mycelium which cements them to the cane; later, the margins and tips of the still living leaves become seared and brown and the general colour of the plant becomes yellow. If at this stage rains come, some revival takes place but the plants never fully regain their normal vigour.

A second phase is met with towards maturity. The terminal buds on the feebler stalks die and the soft growing tissues beneath them become rotten. This "top rot" has often been commented upon but never adequately explained.

It differs from that met with in "dead-hearts" or poorly grown overshadowed shoots of the bunch, and the author regards it as a direct stage in the complex of troubles embraced under the name of root disease. Soon after the top has rotted, black pustules of *Melanconium sacchari* (rind disease) appear on the stalk, usually near the apex, but often further down wherever an injury or borer hole lays the tissues bare.

Finally, the ratoons of affected plants partially or completely fail to grow, unless taken up and replanted, a proceeding which the author states has become part of the routine practice on the cane fields in Porto Rico. As will be seen later, these various stages in development are caused by a whole series of different organisms, with one exception saprophytes or feeble or facultative parasites.

A brief résumé of the chief papers on the subject of root disease in various countries is then given, and this adds greatly to the value and interest of the paper.

WAKKER, in Java (1895), was the first to assign a definite cause to this disease, in that he found a small mushroom on the trash at the base of diseased stalks, which he named *Marasmius sacchari* and considered the cause of the trouble. HOWARD (1899-1902) paid considerable attention to the disease as it appeared in the West Indies, first identifying it as the same as that in Java and, later, finding the Marasmius and, after various experiments, being convinced that Wakker's diagnosis was correct. And in this he was followed and supported by LEWTON-BRAIN, BANCROFT, TEMPANY, STOCKDALE, and other scientific officers of the West Indian Agricultural Department.

COOK and HORNE, in Cuba (1904-8), found the white mycelium at the base of plants suffering from root disease, but assigned this to two other mushrooms of the same general class, and accordingly suggested that these were the cause of the disease, but without supplying any scientific evidence therefor. In 1909 HORNE found the Marasmius mycelium in its characteristic place on the sugar cane as well as on Johnson grass, Para grass, and Guinea grass. He appears to have then accepted it as the cause of the root disease in the canes, but again without any proper evidence.

LEWTON-BRAIN identified the disease in Hawaii (1905), and in the following year found the Marasmius, or rather a form which COBB named *Marasmius sacchari var. Hawaiiensis.* But the latter observer published an elaborate illustrated paper on another fungus, one of the stink-horns, the beautiful *Ithyphallus coralloides*, and pointed to it as assuming the principal rôle in root disease : there was no proof offered and, from the harmless nature of fungi of this class, this paper is dismissed by EARLE "as one of the curiosities of pathological literature."

FULTON (1908) described the root disease in Louisiana and ascribed it to a Marasmius, but to a different species which was named *M. plicatilis* by WAKKER.

A considerable gap now occurs, as the next paper referred to is a joint one by JOHNSTON and STEVENSON on work in Porto Rico in 1917. And here we see a change in the point of view. They name a number of mushrooms, Himantia, Odontia, and Marasmius, which they found forming mycelia at the base of diseased canes, and point out that no proof really exists that Marasmius is the active cause of root disease.

LYON (1919) describes a totally different fungus in Hawaii, to which he attributes both the root disease of the sugar cane and the wilt disease of the pineapple. This fungus he places among the Chytridiaceae, and its vegetative stage consists of numerous naked plasmodia in the soft parenchymatous cells of the roots, which it kills and thus opens the door to a number of secondary organisms.

This concludes the summary presented by EARLE of papers dealing with root diseases. We are fortunately able to carry the list one step further, for in the same number of the journal that contains Earle's paper there are two short ones by MATZ[1] on the same subject. In the first of these the results of a series of inoculations of cane roots by various fungi are described. Rhizoctonia, Trichoderma and Pythium were found in the tissues of the young roots and pure cultures of these were made: to these were added pure cultures of Marasmius and Odontia, and young cane roots were infected with all of them. The result was, generally, "that while Rhizoctonia and Pythium gave positive results, Trichoderma, Marasmius and Odontia did not affect the young roots."

In the second paper MATZ describes a new vessel-plugging fungus also isolated from canes suffering from root disease, and from its character he considers it to be a Myxomycete of the nature of a Plasmodiophora, well known as an active parasite. The results recorded in these two papers are referred to by EARLE, although they do not appear to have been published when he prepared his summary.

The following are the main conclusions arrived at by EARLE after summarizing the literature on root disease given above. He concludes that Marasmius is, at best, a very feeble parasite, and that the cane roots are destroyed in the first stage of root disease by Rhizoctonia and Pythium, long known as root parasites, especially in beds of seedlings the world over. In this destructive work these fungi are assisted, firstly by an enfeebled condition due probably to defective treatment of the cane plants, and secondly, by the Myxomycetous fungus discovered by MATZ, which EARLE calls the "bundle fungus." In a note, the author draws attention to the fact that the action of Pythium in killing cane roots has been dealt with in papers which he had not seen when writing the above. In Java, years ago, TREUB and WAKKER wrote papers on the subject and, quite recently, CARPENTER in Hawaii (1919) assigns the root disease of the cane, the pineapple wilt, and the root rots of taro, bananas and rice, to its action, thus corroborating Matz's results in Porto Rico. This destruction of the cane roots accounts for the early stages of root disease, and the result of their action is very similar to that brought about by the attacks of various insect pests underground.

The top rot stage is more complex, in that the author considers that the newly discovered bundle fungus may be looked upon as the main cause, its action being hastened by the invasion of the enfeebled tissues at the apex by a whole set of bacteria and fungi, culminating in the destruction of the cane by *Melanconium sacchari*. And it is interesting that all of these organisms, excepting the bundle fungus, are considered by the author to be saprophytic or merely facultative parasites, and that he also includes in this category *Colletotrichum falcatum*, hitherto regarded as a dangerous parasite causing the well known red rot of the stem, which has swept over the whole cane-growing world. At any rate, EARLE states that this fungus appears to be less feared in Porto Rico than elsewhere. There is obviously a great field for accurate work on the fungus pests of the cane opened up by these papers in Porto Rico and those recently published in Hawaii. The failure to ratoon after root disease may seem to be a foregone conclusion, but it is a very serious factor from the economic point of view.

In a second part of this stimulating paper the author deals with the relative resistance of root disease of different varieties now being tested in Porto Rico. His deductions were based on an inspection of the 171 kinds put down for a comparative test as to liability to the mosaic disease. As many of these were seen to be suffering, although comparatively free from mosaic, he suspected root disease; and made a summary of the percentages in which top rot (which he considers an integral part of root disease) was in evidence. Without concerning ourselves here with the validity of this method, we pass to the classification of his results. He divides the varieties into five groups, as follows:—

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[1] J. MATZ. "Investigations of root disease of sugar cane," and "A new vascular organism in sugar cane." *Journal of the Department of Agriculture of Porto Rico*, iv, 1, Jan. 1920.

(1) Practically immune to root disease: Kavangire, P.O.J. 36, 105, and 234.

(2) Highly resistant and with no top rot: B 4596 and three local Porto Rico seedlings.

(3) Varieties showing good general conditions and with only 2-5 per cent. top rot: B 3578, B 6540, P.O.J. 228, Sealy seedling, Fortuna seedling, and 9 local seedlings.

(4) Kinds not available, having been cut for seed as the best grown for the purpose: probably therefore similar to classes (2) and (3): B 109, B 3859, D 433, Cavengerie, and 20 local seedlings.

(5) The rest, with 15-100 per cent. top rot, were considered as likely to prove a total loss: only in classes (1) to (4) were the canes reported as likely to produce a commercial crop.

As a result of this inspection EARLE draws an "impressive lesson" from the characters of the members in class (1), and points out that they all have North Indian blood in them. One method of combating the disease is thus obviously to produce hybrids between North Indian canes and the better tropical ones, work that has been persistently followed in the Coimbatore sugar station for the past eight years. He is justified in drawing attention, as has been done by the writer of this article (*I.S J.*, 1920, p. 75) to the fact that Kavangire (Uba ?) and these hybrids cannot compete with the old kinds and good tropical canes generally in milling qualities. He urges the point that all of the fungi that have been met with in his study, excepting the bundle fungus, are unable to attack healthy plants, and he insists that, for these reasons, the chief line of attack should rather be the improvement of agricultural methods, long known as the best weapon for fighting fungi of this character. The measures recommended are "the more abundant use of properly balanced fertilizers; careful attention to drainage where needed as well as the avoidance of unnecessary ditching; most important of all in Porto Rico, sufficient cultivation with implements to keep the soil open and porous and to prevent crusting; the use of irrigation when soil and climate conditions demand it, and proper selection and handling of seed before planting."

The general point of view of the author with regard to this most serious of cane diseases the world over appears to be that the cultivation of the cane is very much neglected, that the soils are no longer as fertile as they were before the more recent intensive growing of sugar cane, and that the attention, at any rate in Porto Rico, should now be definitely directed to keeping the lands in good condition. Incidentally, he expresses the view that the so-called degeneration of such magnificent kinds as the Bourbon is rather a degeneration of the soil than that of the cane, and that this variety, suited naturally to rich open soils, has everywhere been pushed out by kinds which, although inferior in milling qualities, can be grown on the hard, compacted soils of present-day sugar cane estates. This is a matter of serious consideration, although doubtless the point of view will be challenged by planters who consider that their cultivation is all that the cane plant needs.

C. A. B.

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* Mr. J. P. FOSTER has tried sprinkling seed cane with warm water with such good results in hastening germination that the erection of a suitable apparatus for putting this principle into practice is being planned. As the result of the sprinkling, cane sprouts are out of the ground in 24 hours, instead of two or three days; and it is said that such canes are stronger, make a better stand, and mature two or three weeks earlier than cane not so treated.

The Origin of the Uba and Cavengerie Canes.

By NOËL DEERR.

THE UBA.

During the past year a discussion concerned with the origin of the Uba cane has appeared in the pages of this journal, and to this discussion Dr. BARBER, Mr. ALFRED WATTS, and the present writer have contributed. The matter was of sufficient interest to attract the attention of Mr. W. S. HERRIOT, of Glasgow, who took up the matter with Mr. DANIEL DE PASS, lately of the Réunion Estate in Natal. The first named has placed before the writer, with leave to use, the correspondence referred to.

It appears then that the firm of de Pass imported canes from both India and Mauritius to Natal. A certain cane, believed by Mr. DE PASS, Sen., to have come from India, was planted by him. The label attached to the packet was damaged and only the letters *Uba* were decipherable; at the time it was thought that these letters represented only a part of the name, whereas it is now almost certain that they formed the complete title. Knowing that at very nearly the same time canes from both Mauritius and India were obtained by the firm of de Pass, it is conceivable that the package stated by Mr. DE PASS, Sen., to have come from India really arrived from Mauritius, and if this is so, the whole matter becomes clear and may be put in the following sequence.

1. At an early time some unknown Portuguese mariner brought a cane from India to Brazil,[1] leaving specimens at Angola; or perhaps this cane travelled back from Brazil to Angola.
2. This cane received the name of *Uba*, connected with the native Brazilian *Vuba* used as early as 1650 as a name for the sugar cane.[2]
3. In 1869 this cane, under the name *Uba*, was exported to Mauritius from Brazil.[3]
4. In 1882 the firm of de Pass imported the Uba cane as *Uba* from Mauritius to Natal, where arose the confusion associated with the unfamiliar name.
5. The term "Japanese Cane" associated with the Uba merely implies that at some time or other the cane travelled from India to Japan, and from Japan to other parts of the world.

THE CAVENGERIE.

Among the widely extended varieties of canes of less importance occurs one of a red colour characterized by an olive green almost black stripe. The literature of the cane contains many references to this variety. I have illustrated it in "Cane Sugar" as Port Mackay, its most common name in Mauritius, where I found it also called Cavengerie, under which name COWGILL has recently given a detailed morphological analysis of the variety. This cane is also referred to as a Ribbon cane by DELTEIL, using the spelling Scavenjerie.

The earliest reference to this cane that I can find occurs in the *Sugar Cane* for December, 1870 (p. 674), where, referring to importations from New Caledonia to Mauritius, occurs the name Kanangari; no description is given. Recently I obtained access to Sagot and Raoul's "Manuel Pratique des Cultures Tropicales,"[4] where is given a detailed list of New Caledonian canes transcribed from an Mss. of a M. GRESEAN, and dated 1884.

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[1] *Cf.* the statements of the writer, Dr. BARBER, and of Mr. ALFRED WATTS in this Journal, 1918, 164, 406; 1920, 326

[2] *Cf.* DEERR, *I S.J.*, 1918, 164.

[3] *Loc. cit.*

[4] This work is referred to in French textbooks as Raoul's, but appears to be indexed in libraries under *Sagot*.

Under the title Kavarangri, and elsewhere Kavarangi, is described a cane:—Grosse canne rouge foncé, laissant voir des reflets carminés, ayant souvent de grosses dimensions et depassant alors trois mêtres. Ne fleurit pas; très racommadable par la quantité de sucre qu'elle rende. Donne beaucoup de rejetons mais ne viens pas très grosse dans les terres trop legères.

It was recently shown me by Dr. F. S. EARLE that in Porto Rico, where this cane remains in fairly extensive cultivation under the name of Caña Francesca, three sub-varieties connected by a cycle of sporting are known—the striped, the black, and the red; and herein probably lies the confusion which has resulted in the striped cane being called sometimes Cavengerie, the original description evidently relating to the self-coloured red sport.

It is evident, then, that this cane originated in New Caledonia, and travelled to Mauritius. Thence it was introduced to Porto Rico after the epidemic there of 1872; it reached Brazil (*cf.* this Journal, 1920, page 326) and unhappily became christened Louzier there, under which name it was sent to Argentina. It is also grown in Australia, a returned traveller telling me that in some places there it had been misnamed Cheribon. Where and how its name as Kavangire got transferred to the Uba I have been unable to find.

The Java Canes in Tucumán.

Some Large-Scale Results.

By ARTHUR H. ROSENFELD

Field Manager, Santa Ana Plantations Tucumán.

In previous articles in this journal[1] the author has discussed the introduction of the Java canes into Tucumán and their rapid replacement of the "native" canes (Cheribon striped and purple) which had been exclusively cultivated for generations, to the great benefit of the industry of the province just at a time when it was facing the most serious crisis in its history, due to the pronounced degeneration and falling off in yields of the varieties then under cultivation.

For those who have followed these articles and this remarkably rapid substitution of varieties which has resulted in the saving of an entire industry from total ruin, some comparative data from large-scale plantings of the three most successful Java varieties in Tucumán—the P.O. J. 36, 213, and 228—may be of interest.

The accompanying table gives the comparative results obtained from stubble cane in the 1919 Santa Ana harvest from twenty-two large fields (these fields average about twenty-five acres each) of the P. O. J. 36, thirteen of the P. O. J. 213, and two of the P. O. J. 228, the complete chemical data being available for all of these fields, which represent some one thousand acres. They may be taken as fairly accurately representing the comparative values all over the province to-day, the P. O. J. 36 having gradually come to occupy first place in the preferences of the planters, although a much larger proportional area of the P. O. J. 213 was at first laid down, while the P. O. J. 228, aside from being a late maturer, is now generally recognized as being a much more delicate cane in every sense than its sister varieties and, hence, on the average giving much lighter yields. It has the advantage of being a very quick germinater and erect grower, thus permitting reduced width of middles and more rows to the acre; and it does not have the defect of falling so characteristic of the P. O. J. 213—the greatest defect of this latter variety.

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[1] "The Most Promising Varieties of Cane under Trial at the Tucumán Experiment Station" XVI, 1914, pp. 12-23. "What the Tucumán Experiment Station has done for the Argentine Sugar Industry" XXI, 1919, pp. 488-493. "Some Notes on the Tucumán Sugar Industry." XXI, 1919, pp. 606-608.

I.—Java, 36—P.O.J.

Field.	Metric tons per hectare.	Brix.	Sucrose.	Purity.	Manufacturing Value.	Kilos Sugar per hectare.
1	77·90	16·7	12·94	76·5	9·90	5·398
2	35·40	16·8	13·61	81·0	11·02	2·731
3	45·45	15·5	11·25	72·5	8·16	2·596
4	55·15	16·3	12·76	78·2	9·98	3·853
5	54·30	14·4	10·97	76·1	8·35	3·173
6	52·40	16·0	12·62	78·9	9·96	3·655
7	68·25	14·0	9·50	67·7	6·43	3·072
8	60·20	12·9	10·94	84·8	9·28	3·841
9	60·20	13·2	9·14	69·2	6·32	2·616
10	46·55	13·6	9·20	67·6	6·22	2·027
11	59·25	15·2	11·78	77·5	9·13	3·787
12	57·55	13·5	8·88	65·7	5·95	2 397
13	52·95	14·5	10·25	70·8	7·26	2·691
14	43·75	16·7	12·86	77·0	9·90	3·039
15	60·25	16·5	12·74	77·2	9·84	4·150
16	58·45	18 6	13·26	71·2	9·44	3·862
17	63·65	17·2	14·15	82·2	11·63	5·182
18	52·20	13·8	9·20	66·5	6·12	2·236
19	57·35	16·2	11·27	69·5	7·83	3·143
20	75·20	14·2	8·63	60·7	5·24	2·758
21	73·10	16·1	12·18	75·6	9·21	4·713
22	71·80	16·1	12·55	77·9	9·78	4·915
Average	58·24	15·4	11·39	73·8	8 50	3·447

II.—Java, 213—P.O.J.

Field.	Metric tons per hectare.	Brix.	Sucrose.	Purity.	Manufacturing Value.	Kilos Sugar per hectare.
1	39·85	14·4	11·56	80·1	9·26	2·583
2	71·95	16·3	13·69	83·9	11·49	5·787
3	51·80	15·2	11·83	77·6	9·18	3·329
4	54·50	16·1	12·20	75·7	9·24	3·525
5	54·15	16·6	13·05	78 6	10·26	3·889
6	38·00	12·9	8·71	67·8	5·91	1·572
7	51·40	13·5	9·38	69·3	6·51	2·342
8	59·85	13·8	9·22	66·5	6·13	2·568
9	55·55	16·0	11·44	71·5	8·18	3·181
10	58·85	16·3	12·45	76·3	9·50	3·916
11	55·45	14·2	10·82	76·1	8·23	3·194
12	62·35	15·5	12·38	79·9	9·89	4·316
13	44·25	15·9	12·75	80·4	20·25	3·175
Average	53·70	15·1	11·48	75·7	8·77	3·337

III.—Java, 228—P.O.J.

Field.	Metric tons per hectare.	Brix.	Sucrose.	Purity.	Manufacturing Value.	Kilos Sugar per hectare.
1	40·75	14·5	10·10	69·8	7·05	2·011
2	28·05	14·4	10·08	70·0	7·01	1·376
Average	34·38	14·5	10·09	69·9	7·03	1·694

The P. O. J. 36 is also a rather quickly germinating variety and has a very upright character of development, though in neither case are these characteristics so pronounced as in the case of the P. O. J. 228. In average richness of juice it is probably slightly inferior to the P. O. J. 213, although under normally favourable conditions it can generally be counted on to offset this defect by giving around 10 per cent. better agricultural yield.

Under favourable conditions of any sort, however, neither of the two other varieties can compare with the P. O. J. 213 as an all-round cane, and for this reason the Argentine planters will always do well to maintain at least one-half of their plantations in this variety. Under severe drought conditions it is a very slow germinator, but, even under the most extreme of such conditions, it will not dry out and perish entirely as the P. O. J. 36 or 228, and, with the first rains, is up and away as no other cane that the author has ever observed. The effects of late cutting on the succeeding crop of this variety are also far less noticeable than with the other two varieties under discussion, whereas its recovery after hail, as the author has this year had occasion to note, is little short of marvellous.

On 17th December, 1919, about one-third of the plantations on the Santa Ana estate, which were then almost ready for the lay-by, were practically swept away by a hailstorm such as the writer hopes never again to have the misfortune to witness. The hail lasted exactly twenty-two and a half minutes in the centre of the storm and was accompanied by a sixty-mile wind—a veritable tornado—the hailstones coming along almost horizontally and with such force as to leave all brick and concrete walls with southern exposure as pitted as if they had been fired into with machine guns. After the piled up hailstones melted, which was not for six or seven hours in the open fields *although the maximum temperature that day was 105° F. in the shade*, not a cane plant could be seen standing erect, and two or three days afterwards the entire zone which had been scourged by the hail looked exactly as if a prairie fire had swept over it, leaving not a vestige of green in its wake. Nevertheless, with only four months growth, the P. O. J. 213 in this zone re-erected itself as if nothing had happened and has in this crop given us an average yield of about fifteen tons of cane per hectare, whereas the P. O. J. 36 in the same zone has not produced more than 50 per cent. of that quantity. Of course this is an extreme case which is not likely soon to be repeated; but all of these points should carefully be borne in mind by the planter who is selecting the basis for his future plantations.

The P. O. J. 36 is a thicker, handsomer cane than the P. O. J. 213, and cheaper and quicker to cut and strip, as the leaf-sheaths adhere much less tenaciously than in the P. O. J. 213. In the writer's opinion the Argentine planters should so plan their fields as to be able to employ the P. O. J. 213 for very early and very late harvesting and the P. O. J. 36 in the middle months.

Indications in the United States point to the probability that the domestic consumption for the year 1920 will very little if at all exceed four million tons, or roughly 360,000 tons less than in 1919, and some 700,000 tons less than was expected earlier in the year. It is this big deficiency in the U.S. domestic demand that has had so much to do with breaking the ring of high prices that reigned supreme during the summer.

The annual report of the Cuba Cane Sugar Corporation gives figures of the increased cost of producing sugar in Cuba. The manufacturing cost, excluding the cost of cane but including the cost of placing on board steamers at the ports, came to 1·94 cents per lb., while the total cost including the cane amounted to 8·523 cents per lb. In the past five years the manufacturing costs have more than doubled. A lower production cost is, however, foreshadowed for the coming season in the expectation that labour will be cheaper.

Millets for Fodder on Sugar Estates.

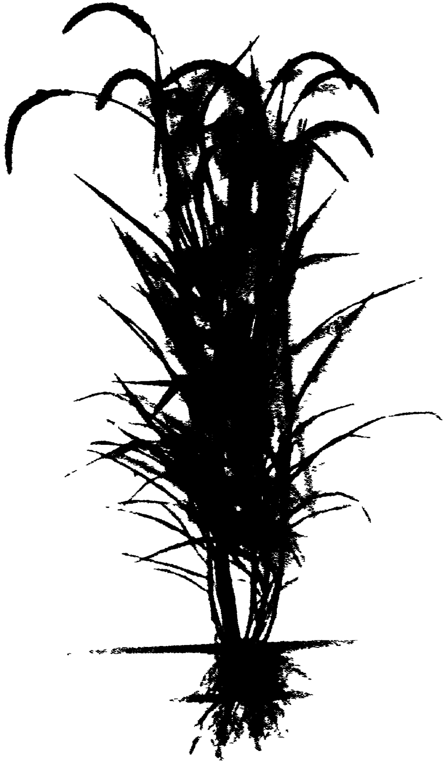
By C. A. BARBER, C.I.E., Sc.D., F.L.S.

II. THE LESSER MILLETS.

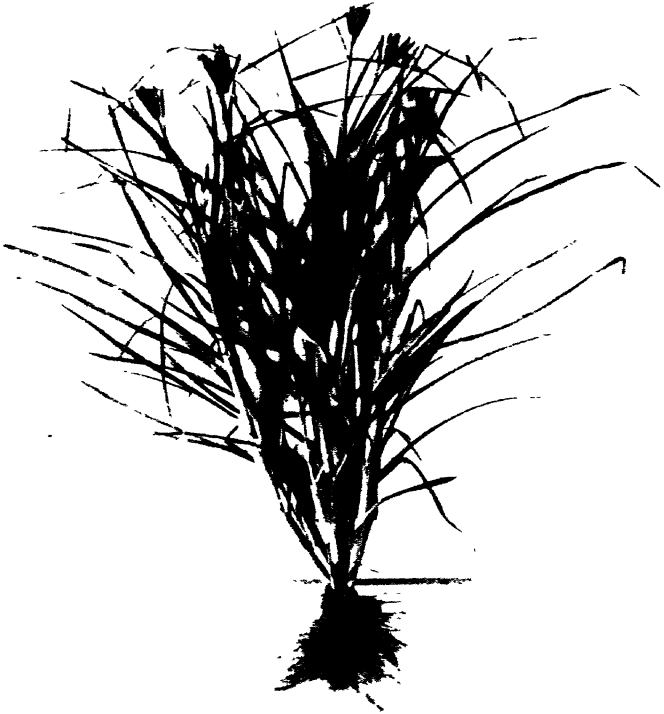
After the remarks on millets in general in the two preceding papers (*I.S.J.*, 1920, pp. 493 and 613), and the somewhat full treatment of the great millet, Sorghum, as a type, it would entail a good deal of repetition to write at all fully about the smaller species which make up the class. In the following, the three chief ones have been selected for a more complete study, and it may be assumed that the rest, gradually tailing off into wild grasses only used as food in times of famine but often planted as fodder for cattle, may merely be recorded, (*Ib.* p. 494) although it is impossible to give such a list in full. Taking the whole series, from the great millet to the wild grasses, there is a regular diminution in the amount of care that they require in cultivation, this being of course coupled with a like decrease in the value and quantity of the crop, both in grain and fodder obtained. There is thus a wide field for selection, according to the purpose held in view by planters inclined to give them a trial, and the character of the land to be planted with them. Some details have already been given (*I.S.J.*, 1920, p. 494) of *Pennisetum typhoideum, Setaria italica*, and *Eleusine coracana*, and photographs of plants dissected by the author to show the range of the rooting system are given here of the two latter and two of the smaller millets, *Panicum miliaceum* and *P. frumentaceum*, to serve as types for the remainder. The double lines in these photographs indicate the upper limits of soil and subsoil, and the roots are spread out in the position in which they were found in the dissections. A few more notes will now be added regarding the first three of these millets, easily the most important from the crop point of view.

BULRUSH MILLET, *Pennisetum typhoideum*.—This plant stands in some sort half-way between Sorghum and the lesser millets. It resembles Sorghum in certain respects. It has erect solid stems of some thickness and reaches a height of five to six ft. : at the base aërial roots are met with which act, as in Sorghum, as supports for the plant, for it must be remembered that all of the millets are shallow-rooted and the taller ones are liable to be overturned by sudden gusts of wind : bulrush millet furthermore favours the lightest of soils. Like Sorghum it is proterogynous, the female flowers in each spike being receptive before the pollen is scattered : and thus this crop is wind pollinated and is liable to injury by rain showers at the time of flowering, indeed more so than in Sorghum. Heavy rain showers are specially harmful to bulrush millet at all times, whether by drowning the young seedlings, turning the leaves yellow when in active growth, in the flowering season, or by causing the grains to sprout and spoil in the head at maturity. But it differs from Sorghum in the form of the ear which, as a long, smooth cylinder, bears a close resemblence to that of the bulrush, after which it is usually named : it tillers much more freely, so that a number of ears are borne on the same stool, and the leaves are much narrower.

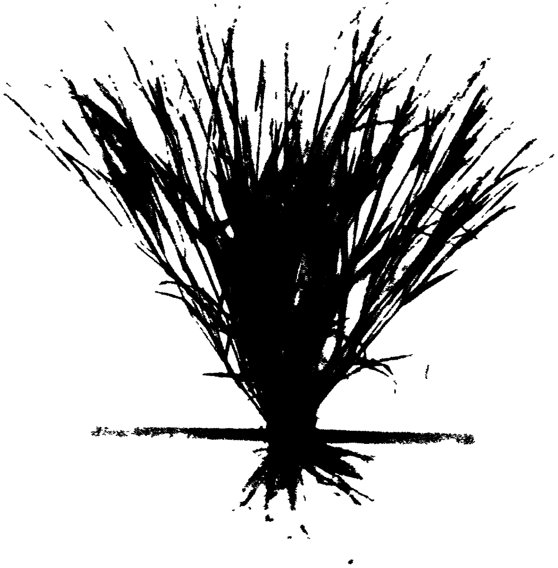
The plant is a typical catch crop, matures very quickly and requires considerably less manure, a lighter soil and less cultivation than Sorghum. It is widely distributed over eastern Asia and the African continent, from India to China and Japan, and from Tripoli, where as "Shessāb" it is recommended as a valuable irrigated fodder crop, and Egypt, where it is grown for its grain, to the Transvaal, which has an excellent variety, excelling those of India in vigour, rapidity of growth, length of spike and size of grain. In India there are many



Setaria italica



Eleusine coracana



Panicum miliaceum.

Panicum frumentaceum.

varieties, differing in quality and quantity of straw to grain, character of grain and the ease of clearing it from the husk, size of spike, etc., and in one part the ear is provided with long awns or bristles which protect it from the inroads of birds, the chief enemy of the crop. While the smaller birds perch on the ear and go through the hidden stores of grain methodically, the larger ones, such as the parrots which sometimes descend in immense numbers on the fields, cut the ears right off and fly to some tree where they pull out half the grain and waste the rest.

The straw is not usually liked by cattle, although it does not appear to be deficient in feeding value. The grain is nutritious and heating, so that it is said to be a favourite in North India in the colder part of the year. In whole tracts it is the main cereal of consumption and there are some 15,000,000 acres of it in India, where alone the returns are available. The seed rate varies from 3 to 10 lbs. per acre according to the character of the soil, but when, as is often the case, it is sown as a mixed crop (for instance with ground nut, an excellent combination) a good deal less is required. The yield varies enormously according to conditions : an average crop will be 300 lbs. to the acre, but as much as 1000 lbs. may be obtained under favourable conditions as a dry land crop and double that quantity when irrigated.

ITALIAN MILLET, *Setaria italica.*—This is a very graceful millet, as can be seen from the picture. According to some authorities it is the most important millet cultivated, but one doubts whether the dominating character of Sorghum has been realized by these. Cultivation of Setaria is known to be very ancient, as it is one of the sacred crops of the Chinese, recorded as planted with much ceremony by the Emperor and his courtiers nearly 3000 years B.C. It is impossible to assign a native country to so old a cultivated plant, but it has been found in the Swiss lake dwellings, showing that it had a wide distribution in prehistoric times. At present its greatest development appears to be in China, Japan and India, but it is world wide in its distribution, being used chiefly as grain in the three countries mentioned above and more as a fodder in Europe, Canada, the United States and South Africa, where it is known as "Boer manna."

In Madras there are about 2,000,000 acres, and it is often planted in alternate rows with cotton and other non-cereal crops. The seed rate is given as 5 to 6 lbs. per acre if irrigated, half of that quantity if on dry land and of course still less if grown as a mixed crop. The yield as a dry land crop reaches 600 lbs. of grain per acre, and if irrigated 1000 lbs., with 1000 to 2000 lbs. of straw. There are, as in bulrush millet, many varieties, chiefly in the amount of branching and thickness of its rope-like, nodding ears and in the size and colour of its grain. As in other millets it is eaten as unleavened cakes or porridge.

RAGI, *Eleusine coracana.*—This millet forms a class by itself, and has many characteristic wild relatives : it always strikes one as a wonder therefore that it has such valuable properties. As the Indian flora contains a number of these wild relatives it is usually considered to be indigenous to that country. It is a moderately tall, tufted grass, with the ear divided into a number of radiating branches, after the manner of a bird's foot. It is cultivated as a cereal over India and Japan and parts of Africa, but there is not much literature available on the subject. It is largely grown in India, in the south as an important irrigated crop, but elsewhere rainfed, both in the plains and on the hills at the onset of the monsoon. Its cultivation in South India is very carefully attended to, the seedlings being raised in special, well treated nurseries and then transplanted to land constantly kept moist, in these respects resembling paddy. About 2 lbs. of seed will plant up an acre of land: this may seem a very small quantity, but it is very productive and the seeds are very small, there being 157,500 to the lb. The yield is 2000-3000 lbs. per acre with up to 8000 lbs. of straw. As a wet crop it is invariably planted pure, but on dry land it is often mixed with pulses, oilseeds and other crops. There are several varieties, two main groups being distinguished by having the radiating branches of the ear spread out or closed in, after the manner of the human hand: in the form figured the ear is open. It is a very hardy crop and will grow where scarcely any other can be planted: the wet land forms are noted as specially resistant to alkali and salt, and ragi is often grown as a first crop on reclaimed land before it becomes fit for paddy.

Harvesting is difficult because of its habit of branching high up and thus bearing ears of different ages; the sickle is used or the ears are merely taken off by hand, and there have to be several reapings. It is supposed to be the most prolific of the grain class, and a record has been made of a single seed which gave rise to 56 upright stalks with 8100 grains. About 25,000,000 cwts. are computed to be consumed every year in India alone. The porridge made from it is not unpalatable, especially when mixed with coconut milk, as the writer can testify, having frequently used it as a welcome change from oatmeal in the hot weather. It is specially valued by all engaged in heavy manual toil and is the general regimen in jails, as it is a very strengthening food. On one occasion, when the writer's supply of American flour gave out far from the sources of supply, he was compelled for a couple of weeks to feed on ragi porridge and cakes, and he noted that he was able to do the most surprising marches without excessive fatigue. Ragi straw, which is fed half green, is considered a very good fodder.

The following analyses of the grain and straw of millets, paddy, and wheat, which have been taken out of a useful little Madras publication, R. C. WOOD, "Notebook of Agricultural Facts and Figures," may be of interest to readers. The writer is indebted to the same publication for most of the figures of seed rate and yields.

Grain.

	WATER.	PROTEID.	OIL OR FAT.	CARBO-HYDRATE.	CRUDE FIBRE	ASH.	NUTRITIVE RATIO[1]
Sorghum	10·71	9·71	3·69	72·38	1·54	2·05	1 : 8·3
Ragi	11·29	9·44	4·93	60·13	6·56	7·65	1 : 7·5
Varagu[2]	8 84	8·04	4·57	65 20	7·39	5·95	1 : 9·5
Kambu[3]	8·77	9·52	5·33	73·52	0·78	2·08	1 : 9·0
Paddy	12·55	6·35	2·14	65·29	7·84	5·83	1 : 11·0
Wheat	13·33	9·74	1·76	70·18	2·10	2·98	1 : 7·7

Straw.

Sorghum	8·70	2·10	1·50	39·67	39·77	8·24	—
Ragi	14·16	1·94	0·62	49·11	28·93	5·24	—
Varagu	8·71	1·97	2·51	47·92	28·84	10·05	1 : 26·8
Kambu	7·07	1·94	1·33	43·99	37·63	8·04	1 : 23·5
Paddy	11·04	2·70	1·02	40·84	29·23	15·17	—
Wheat	8·71	3·01	0·98	37·93	35·69	13·93	1 : 13·0

Dr. NICHOLAS KOPELOFF, who has recently contributed several interesting papers on the deterioration of sugar, has resigned his position on the staff of the Louisiana Sugar Experiment Station to accept the appointment of associate in bacteriology at the Psychiatric Institute of the New York State Hospitals.

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[1] Proportion of nitrogenous to non-nitrogenous constituents of the food

[2] *Paspalum scrobiculatum.* [3] *Pennisetum typhoidum.*

Notes on the Lincoln Tractor Trials, 1920.[1]

By THOMPSON CLOSE, B. J. OWEN, B.Sc. (Eng.), and
H. G. RICHARDSON, M.A., B.Sc.

The recent trials of farm tractors at Lincoln were organized by the Royal Agricultural Society of England in conjunction with the Society of Motor Manufacturers and Traders, who were responsible for the highly successful trials of last year.[2] The trial ground was in close proximity to that chosen in 1919, and presented very similar features. The chief difference between the two trials was the method adopted by the Royal Agricultural Society of placing machines in a definite order of merit and awarding gold and bronze medals. In certain classes where the competitors numbered only three (some reduced to a single tractor), two and one, this method had an air of unreality, and the competition was in effect restricted to classes 1, 2 and 7.

Entries were accepted under seven classes, which are set out below. It will be observed that there were three classes for internal-combustion tractors, one for steam tractors, one for "self-propelled ploughs," and two for cable sets; the last-named, it will be recalled, did not figure in the 1919 trials.

Class 1.—Internal Combustion Direct Traction, not exceeding 24 H.P., suitable for ploughing two furrows 10 inches wide by 6 inches deep.

Class 2—Internal Combustion Direct Traction, not exceeding 30 H.P., suitable for ploughing three furrows 10 inches wide by 6 inches deep.

Class 3.—Internal Combustion Direct Tractor, over 30 H.P., suitable for ploughing four furrows 10 inches wide by 8 inches deep.

Class 4.—Direct Traction Steam Engine, suitable for ploughing four furrows 10 inches wide by 8 inches deep. Engines to comply with Light Road Locomotive Acts.

Class 5.—Internal Combustion Double Engine Set, with wire rope haulage for ploughing three or four furrows 10 inches wide by 8 inches deep. Engines to comply with Light Road Locomotive Acts.

Class 6.—Double Steam Engine Set, with wire rope haulage for ploughing three or four furrows 10 inches wide by 8 inches deep. Engines to comply with Light Road Locomotive Acts.

Class 7.—Self-propelled plough for ploughing not more than four furrows of not more than 10 inches wide by not more than 8 inches deep.

Design.—Among the machines competing in the various classes there was striking uniformity in design and construction, although it is possible to divide the whole of classes 1, 2, 3 and 7 into two main types:—

(*a*) Those in which the whole of the machinery is built up in one block of casting, i.e., there is no frame;

(*b*) Those in which there are separate units on a frame.

Broadly speaking, very little difference was observed between the machines which competed this year and last year. It would seem as if for the time being the manufacturers regard design as having reached finality, and are content with minor improvements. In this connexion it may be remarked that manufacturers and designers have naturally been strongly influenced by the example of horse ploughing, and have regarded the tractor as a substitute for the horse. This, and the fact that the motor car and tractor industries are closely linked, may have led to the neglect of the possibilities of the conversion of power into rotary motion; the problem is engaging the attention of French manufacturers and will require close investigation in this country. It is one, however, in which the question of the act of cultivation cannot be separated from the question of the tractor, a point to which reference is made later.

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[1] Taken, slightly abridged, from the *Journal of the Ministry of Agriculture*, XXVII., No. 8, 714-724.

[2] See *I.S.J.*, 1919, 538.

Weight in relation to horse-power.—In the more recent designs of tractor there has been a tendency to reduce weight per horse-power, and it was worth noting that the Fordson Tractor—the lightest of all—is only 1 cwt. per horse-power, as compared with 3 and 4 cwt. per horse-power in the case of heavier machines. It is evident, however, that the whole question of weight in relation to horse-power is at present little understood. Weight per horse-power should be, and undoubtedly will be, universally regarded as a necessary element in the selection of a machine for any particular class of work, and though this factor is already ascertainable and will presumably be indicated in the report to be issued on the trials, farmers in general have no idea of what it means in actual practice or its relation to their problems.

Caterpillar-track machines.—Another problem is that of the relative efficiency of wheels and caterpillar track. No definite opinion can be stated until a very protracted test is made under more varying conditions than those which prevailed this year. The caterpillar type is intended to avoid undue weight on the land. The general features of the design are too familiar to need description. The principle is to reduce the insistent weight on each square inch of the land on which the creeper stands, and also to present a very large area for gripping or adhering to the ground. Results so far have demonstrated the superiority of the caterpillar tractor over the wheel tractor on wet soils, where the track machine, with its low intensity of pressure upon the soil, shows itself to greater advantage than on a dry light soil. The wheeled machines practically group themselves in efficiency more or less in proportion to the weight per square inch carried, on the contact with the ground. It was clearly demonstrated in last year's trials that heavy weight is not necessary to provide tractive effort, and that, with efficient forms of grip, light machines are successful.

Many designs of caterpillar track exist, and a discussion on the merits and demerits of each would require a very lengthy statement. There is, however, considerable room for improvement in the chain track itself, as well as in its supports and anti-friction devices. The variation in resistance to haulage and to work is as great as exists between one system and another, not merely in static resistance to starting but to dynamic resistance to haulage. There is ample scope here for investigation and comparative tests at the hands of any research association or institute that may be established in connexion with agricultural machinery.

Adhesion.—Adhesion depends for its effectiveness on three conditions: (1) the amount of wheel or track in contact with the ground; (2) the kind of gripping devices attached to the wheels or track; and (3) the weight of the machine. The second point, to which attention was drawn last year, especially needs further investigation. Various methods are now employed to obtain the adhesion necessary. They fall into three classes:—

(1) Angle iron at an acute angle on the rim of the wheels;
(2) Projecting angle iron at an acute angle to the wheels;
(3) Variously shaped spuds or spikes.

Each class employed at the trials seemed to do its work fairly efficiently, but sufficient data are not at present obtainable for comparison. There is undoubtedly considerable variation both in the adhering power of and the resistance exerted by the different devices, and a searching test should be carried out to ascertain the effectiveness of each type.

Tractor wheels in furrow.—While it may be doubted whether it is in every way desirable to have one of the tractor wheels running in the furrow, it was observed that when this is the case the tractor is more or less self-steering, and allows the operator to direct more attention to the plough. The furrow wheels, however, should be of such a width as not to necessitate the making of too wide a furrow.

New improvements and new machines.—It is not necessary to give a detailed description of the machines which took part in the trials, particularly since the great majority were competing last year.[1] It may be remarked generally that a good deal of attention has evidently been given to points of detail with a view to ease in handling and saving of wear-and-tear.

With one or two exceptions all machines included brakes, and attention has been paid to springing. There were very few exposed gear drives, and in most instances vital parts were fully enclosed, although with due regard to the need for accessibility. In most machines provision had been made for alteration of drawbar connexion in a horizontal direction, but all had not been provided with easy adjustment in a vertical direction, and those not so provided suffered in consequence.

Another point to which some manufacturers had paid attention was the application of a spring appliance for minimising the strain on the machine when the plough struck an earth-fast stone. A release device might have been incorporated with this appliance, to detach completely the plough under the strain of a heavy shock. Such an appliance should, however, be an integral part of the tractor, and not merely a casual device inserted in the drawbar connexion.

Many machines were obviously too complicated for the ordinary farm hand, and the advice given last year, by a well-known farmer, that tractors should be made simple to suit the simple folk in the country, may well be repeated. A remarkable feature possessed by a self-contained machine may be mentioned: it had an electric outfit of a complicated design, which would necessitate handling by an expert mechanic, and the ordinary farm hand would be helpless at the slightest mishap.

Certain of the machines competing for the first time call for a few words of comment. In this connexion it may be remarked that a well-known name is no evidence that a machine is designed on the same lines as a namesake of earlier years; a complete change of design has been adopted in several instances where the old name has been retained.

In Class 1 the new machines were the British Wallis, the new Saunderson, the Case, and the Samson—two British and two American.

The British Wallis is a modified and considerably improved pattern of the old three-wheeled American Wallis. The most obvious alteration has been the addition of another wheel, making it a four-wheeler, but there are many other detailed modifications, which add to its usefulness. The other British machine, the Saunderson, is, as regards the general principles of its design, a replica on a smaller scale of the standard model "G" tractor of the Saunderson Company. It has the same two-cylinder vertical engine and arrangement of clutch, gear-box and final drive.

The Case comes from a well-known American firm, and the machine is very original in detail design from front to rear. One-piece cast frames have been used previously, but never on the style of this machine, in which an extremely strong cast-iron member runs from front to rear, carrying on its front end the radiator; the engine is disposed midway across the frame which, at the rear, serves also to support a gear box and axle case. The Sylphon thermostat is a useful feature of the Case. It is a device, controlled directly by the heat of the engine and cooling water, which operates to bring the engine itself, when starting from cold, rapidly to the temperature at which it will best vaporize fuel, and maintain it at that temperature throughout the whole period of its working. This effect is attained by means of a valve, which is opened or closed as the temperature of the cooling water rises and falls, and which, when closed, throttles the circulating water pipe between engine and radiator, and thus controls the amount of cooling water which passes to the engine.

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[1] For details, see Official Report of the 1919 Trials at Lincoln, of which a review appeared in this journal last June (*I.S.J.* 1920, 343).

The other new American machine in Class 1, the Samson, resembles externally the Fordson. An interesting feature in this machine is the lubricating arrangement. There are only a couple of holes through which oil need be poured occasionally; no other attention of that kind is necessary. The Samson is of the type of machine in which the engine and transmission case are bolted together to form one complete unit which acts as the frame of the chassis.

In Class 2 there were twenty-one machines, and of these no fewer than eight were making their first appearance in trials in this country. Of the eight, three were of British manufacture, one was Canadian, and the remaining four were American.

The British machines were the British Wallis, the Peterborough and the Pick. The first has already been referred to in Class 1. The Peterborough is designed and constructed on excellent lines. The Pick resembles, in general design, the Austin and Fordson types. The most noticeable feature is the overlapping strakes which are embodied in the back wheel construction. This arrangement is cast solid with the main body of the wheel. So designed, the wheel, even on sticky soil, remained unchoked.

The Canadian machine, the Chase, has several interesting features. It is three-wheeled, without the disadvantages usual in that class of machine: it is easily manœuvred on the headlands by eliminating the differential gear and putting the drive on the two rear wheels under the control of the operator, who can, therefore, when turning the headlands, declutch the inside wheel and drive only on the outer.

Among the American machines, the Case is a larger edition of the model entered in Class 1. The Hart Parr is entirely new. The principal point of interest is in the engine, which is a two-cylinder, slow-running horizontal unit, transmitting through a clutch and series of plain spur wheels to the differential on the rear axle. The frame of this machine is also, in the main, a casting made extremely strong with the object of eliminating any risk of distortion.

The Twin City, another new machine, is an American product with an unusual feature in the engine; it has four valves to each cylinder, two for induction and two for exhaust. In designing the frame the manufacturers have made an interesting departure; the frame serves as a casing for the transmission gear, but does not actually form a part of the engine, which is suspended within it.

The Parrett tractor attracted considerable attention, mainly on account of its somewhat unusual appearance, caused by the large diameter and the wide spread of its wheels. This construction has a decided advantage at the headlands, since it considerably facilitates the turning operation.

Performance.—A detailed review of the trials must necessarily await the report of the Judges, but the present opportunity may be taken to give the impressions that were received in watching the machines at work.

Notes on the Lincoln Tractor Trials, 1920.

The ploughing tests were easily performed on the light land by all classes of machines. Every machine appeared to complete its work in practically the same time, and the result approached a fairly high standard. In the case of the ploughing on heavy land the large number of competitors did not permit of each class working the same field. The competing tractors were put to work in three fields, and there was a considerable difference between them in the strength of the soil. The light machines in Class 1 found the work difficult, and, in fact, failed to plough at the required depth. The water in their radiators appeared to be constantly at boiling point, and often the draught registered per furrow in this land was as heavy as 900 lbs., sometimes reaching 1000 lbs. The machines were incapable of pulling a constant load of over 600 lbs. per furrow with three furrows. Undue strain was evident upon the machines, and the representatives in this class certainly took a serious risk in attempting this heavy task. The performance of other classes in the ploughing competition calls for no special comment.

A hauling test was conducted on a hilly road of good surface with a fairly sharp gradient. Many failures occurred, due invariably to the wheels slipping, and not to lack of power. Many of the machines were not equipped for such a test, and ran on smooth wheels, sometimes failing on a gradient of 1 in 9·8. Machines equipped with wood blocks and rubber treads found no difficulty in ascending the hill. Various other tests were made to show the efficiency of the machines under all conditions.

Self-contained machines.—It was observed that these machines were regarded very favourably by many attending the trials. The extreme facility with which they can be steered and handled makes them suitable for short headlands and small fields. Last year the report of the judges showed a very high fuel consumption, which was disappointing, and it is to be hoped that an improvement will be indicated in the forthcoming report.

Cable sets.—Comment has been reserved on the cable sets, which provided a new feature for this year's trials. The steam set does not require special description, but the two internal combustion sets, one manufactured by Messrs. Fowler, and the other by Messrs. McLaren, deserve notice. The former is a powerful machine, each unit being a 60 H.P. petrol engine of conventional type, mounted in the usual position in front with the shaft longitudinal. The winding drum is underneath, as in the familiar steam model, and the whole plant is very substantially built. The McLaren set is a lighter machine embodying a different design; a form of windlass at the rear did the duty of the customary suspended drum.

These equipments are likely to be highly favoured in countries where difficulties are met with in providing coal or wood fuel and a suitable water supply, and where there is an ample supply of oil fuel. In any case, no comparison can be drawn between the cable sets and the mobile tractor, as their work falls in entirely different classes, and only very exceptionally can they ever be in competition.

Costs.—The prices of tractors and self-propelled ploughs vary from about £300 to £600; but the capital expenditure is only one factor, and fuel consumption and general upkeep are points to which farmers need to pay the closest attention. It is true that in a trial of brief duration running costs cannot be estimated with any close degree of accuracy, but the facts elicited over the nine days of the trials may yet be of some assistance in establishing a basis of comparison between machines.

Conclusions.—The awards of gold and bronze medals were announced at the conclusion of the trials, and have been published in the press. Without disparaging in any way the machines which were distinguished by the judges, it may be questioned whether the awards will in any way assist either prospective purchasers of tractors or the tractor industry. Until the judges' report is published it is, of course, impossible to know what were the precise points of superiority upon which the awards were based, but from the nature of the regulations and tests and the duration of the trials it is certain that factors which are of supreme importance could not be taken into consideration. It is very questionable whether under any conditions the competitive element is a desirable ingredient in scientific trials, but until design and construction have attained some definite standard anything in the nature of a competition appears positively undesirable, since uniformity of tests or conditions cannot be obtained. Last year's report demonstrated that even machines of the same make could not be effectively compared and contrasted under the present trial regulations. The statistics showed that identical machines ploughed altogether different acreages per hour at different cost for fuel. From this fact it may be hazarded that if similar machines underwent a similar trial to-day a series of results would be obtained substantially different from those recorded last year.

Apart from those considerations, it must be emphasized that a test of a carefully tuned machine over a few days only, and in the hands of an expert operator, affords no criterion whatsoever of the reliability or the durability of the machine in farming practice; and if this is not demonstrated, any test is robbed of the greater part of its value.

To turn to a more technical point, it may be suggested that the method of classification by the formula adopted to measure horse-power is also open to criticism. This formula was based upon the declared revolutions, the piston area and stroke. Classification by such a formula is clearly open to improvement, as it is impossible to ensure that the competitor will actually run his engine at the revolutions declared. A competitor may, on this account, put identically the same machine in two different classes, the description of the machine being similar, with the exception of the revolutions. In practice this may not be serious, and it will afford makers a chance of putting their machines into the class most suitable for them. The whole question is admittedly difficult. Based on cylinder dimensions, only the extreme high speed can give the best results, although, obviously, this is the least suitable for practical work. A suggested alternative is to classify by weight, which would give a fair standard of comparison.

The decision of the Royal Agricultural Society to require the use of similar ploughs for identical tests has met with considerable criticism, not, it may be suggested, without substance. It is understood that the object was to discover which tractor did the greatest acreage on the least fuel with a given kind of plough. The implied premise is surely a false one. Power to plough two or more furrows is no criterion of the capacity of a machine, for conditions vary with the same plough, even with the same setting—if that is possible to obtain, which is very doubtful.

There seems no practical reason why all kinds of ploughs should not be allowed. No tractor can be tested for efficiency in ploughing if it has not a plough suited to it. As foreign ploughs were excluded, some machines were handicapped; the best results could not be obtained with the ploughs supplied, and it is evident that the results are less valuable than they would have been if every machine had the option of using the plough to which it was best suited. Drawbar pull can be stated in definite figures, and the capacity of the tractor thus ascertained. It would be better if each machine were allowed its own particular plough and if a lengthy dynamometer test, giving definite figures, were adopted. The comparison would be placed on a scientific and easily calculable basis.

Notes on the Lincoln Tractor Trials, 1920.

With regard to the actual ploughs used, it may be remarked that they were efficient, although, as compared with American types, on the heavy side. Considerable trouble was experienced with the "self-lift" device, but this appeared to be due to adjustment and not to weakness in design. The decision to insist upon uniformity of type had the advantage of bringing home to every spectator the need for further research in the design of ploughs. It was shown without question that a plough of the same design and setting will turn a very different furrow at different speeds.

The economical speed of mechanical traction is more than double that of the horse, and the mould boards which will need to be developed are those which will perform the work with greater speed and equal excellence. To the disappointment of many tractor manufacturers, and to the loss of agriculture, plough designers have not yet put upon the market implements which will take into account the requirements of mechanical traction. Undoubtedly a great deal of patient scientific work is called for, and it will be necessary to examine the question whether the type of furrow at present favoured by farmers is essential.

⁂ The following were the prize-winners in the recent Tractor Trials at Lincoln, in their respective classes:—

Class 1.—Case, entered by the J. I. Case Tractor Manufacturing Co., Racine, Wis., U.S.A. *First Prize:* Gold Medal and £20.

Cletrac, entered by H. G. Burford & Co., Ltd., 16, Regent Street, London, S.W. 1. *Second Prize:* Bronze Medal and £10.

Class 2.—British Wallis, entered by Ancona Motor Co., Ltd., 83, Brompton Road, London, S.W. 3. *First Prize.* Gold Medal and £20.

Peterbro, entered by Peter Brotherhood, Ltd , Peterborough. *Second Prize:* Bronze Medal and £10.

Class 3.—Berna, entered by Fabrique d'Automobiles Berna S.A., Olten, Switzerland. *First Prize:* Gold Medal and £20. No award of second prize.

Class 4.—Mann, entered by Mann's Patent Steam Cart and Waggon Co., Pepper Road, Hunslet, Leeds. *First Prize:* Gold Medal and £20. (Only machine entered in this class.)

Class 5.—Fowler's Internal Combustion Engine Cable Ploughing Set. *First Prize:* Gold Medal and £20. (Entered by John Fowler (Leeds), Ltd.)

McLaren Internal Combustion Engine Cable Ploughing Set. *Second Prize:* Bronze Medal and £10.

Class 6.—Fowler. *First Prize:* Gold Medal and £20. (Only one tractor entered in this class)

Class 7.—Crawley, entered by Crawley Agrimotor Co., Saffron Waldon.

Moline Universal, entered by Motrac Eng. Ltd., Long Acre, London, W.C. 2.

An international arrangement has been concluded between a certain number of Allied countries for the establishment of a Central Office of Patents at Brussels This office is to be an organisation of general information and centralization in regard to patents, both from the legislative and the technical points of view, and will be charged with the international registration of applications for patents. While the arrangement does not yet bring about the institution of one sole international patent, valid in all countries adhering to the project (which will still retain entire legislative liberty), it nevertheless will provide inventors with certain advantages, on the one hand, by specifying the formalities and reducing to some extent the expense involved in protecting their rights in several countries, and, on the other hand, in providing at the Central Office competent and impartial authorities to advise them as exactly as possible on the novelty and value of their respective inventions. Further information when available will be given.

Australian Affairs.

(From our Special Correspondent.)

In my last letter, I briefly touched on the leading points in the report of the Royal Commission appointed by the Federal Government to inquire into the conditions governing the sugar industry in Australia—and it may be mentioned here that the Commission went into the highways and byways of the States to fulfil the duty laid upon them. It may now interest your readers to scan some other opinions expressed and recommendations made by the Commission. One remark is apropos at the present moment, in Queensland particularly where a General Election is, at the time of writing, being fought mainly on the financial issue, Mr. THEODORE, the Premier, having gone to the country in an election rushed on the people six months before need be, having in the forefront his alleged grievance against the London financiers, who recently, as the British public are doubtless aware, refused to grant a loan of nine millions sterling unless he and his Government (a Labour one) repealed and amended certain legislation passed by them. The delegation from the Queensland Liberals, including Sir ROBERT PHILP and Sir ALFRED COWLEY -- both keenly interested in the sugar industry—is blamed by the Labour Party for the aforesaid failure, and this is the main bone of contention of the election. Let me here give a few figures showing to some extent how the State Government is financially interested in the sugar mills, and how necessary it is that the finances of the State should be on a firm and stable footing. In the Auditor-General's report on the accounts of the Central Sugar Mills under Government control and self-controlled mills indebted to Government for the year ended June 30th, 1919—the position is, if anything, a little worse now—he states that the "advances made to Central Mills totalled £1,480,230 5s. 8d., of which £454,629 8s. 4d. had been repaid, leaving the indebtedness on Loan Account at £1,025,600 17s. 4d. The arrears of interest due to the Treasury totalled £15,795 6s. 5d., as against £15,825 1s. 6d. for the previous year. The advances from Trust Accounts to the Mills in possession of the Treasurer totalled £194,574 8s. 2d., and the total indebtedness to the Treasury was £1,235,970 11s. 11d., an increase of £64,177 1s. 4d. on the previous year. Gin Gin, Proserpine, Mount Bauple, Nerang, and North Eton passed into the possession of the Treasurer through failure to meet their obligations to the State for interest and redemption, but all mills, with the exception of Gin Gin, North Eton, and South Johnstone, showed a manufacturing profit on the year's transactions." As mentioned in my last letter, several mills failed to start in the 1919-1920 season (after this report was published), and the Nerang Mill (South Queensland) has been re-erected at another site and will crush this season. The Auditor-General continued : " It would appear questionable whether, under existing conditions, profits at these mills [the three last mentioned] can be looked for, principally owing to insufficient cane supply and unsuitable location. The position of the Babinda Mill is considered satisfactory, but no profit or loss is disclosed, as the available surplus was distributed to growers in accordance with the award of the Central Cane Price Board. South Johnstone Mill disclosed a manufacturing loss for the season of £23,528, the total accumulated losses being £70,132. Proserpine had a profit of £5247, and Mount Bauple a year's profit of £529, but after paying a yearly instalment to the Government of £2058 there was a loss of £1529. Gin Gin's loss, with redemption, amounts to £4198, whilst North Eton (Mackay Hinterland) has a total loss of £25,418. Nerang Mill was sold for £11,084, and the State indebtedness was £35,329. At the self-controlled mills, Isis (Bundaberg district) showed a profit of £3091, and is regarded as in a sound position ; Mossman (North Queensland) had a profit of £6481, as compared with £2951 for the previous year; Mulgrave had a profit of £181 (regarded as sound, and Plane Creek (Mackay district) disclosed a deficit of £3886." From the above it can be seen that, prior to the advance in the price for raw sugar, referred to in my last, and which obtains for at least three years, the position of a good number of the mills was far from satisfactory.

But to return to the Royal Commission. The report of this body threw upon the witnesses examined responsibility for the statements made regarding the attitude of financial institutions towards the industry, and stated: "It was suggested in evidence that the banks have become increasingly reluctant to make advances to raw sugar mills for the purpose of improving efficiency or extending their present installation. One reason, in the case of Central Mills, was the insistence of growers upon a higher price for their cane, this preventing the setting aside of adequate reserves for improvement or for even maintaining the present standard. Other reasons assigned were that under the Cane Prices Act the Government had power to take over factories which fail to start crushing according to the terms of the award, and, further, that the standard of 90 per cent. coefficient of work, adopted by the Central Cane Price Board as the basis on which to allow the manufacturer his profit, is said to be out of the reach of many small or inferior factories." In view of the foregoing, superadded to the present high rate for loan money, can it be wondered at that financial institutions do not appear over-anxious to assist the millers? It is hoped, however, that, with an easier money market and a much better price for raws, the path of the miller will be less thorny in the future than in the past. In the early part of this year, however, the Government cited nine mills (none of which are mentioned above) before the Prices Board to show cause regarding their time for starting crushing this season, the alleged reason being that in past seasons "some of the millowners have stated their intention of not crushing, and have declined to prepare their mills for crushing in proper time, so as to exert pressure on the growers to accept the millowners' terms." The Crown Solicitor reduced the mills cited to three, and orders were made regarding these by the Board.

The abnormal world prices for sugar and the effect on Australia, also came under review by the Royal Commission, and the opinion of its members is revealed in the following paragraph, which shows a remarkably clear insight into the conditions covering the Australian industry:—"As the industry stands, nothing is more certain than that a phenomenal rise in price, such as would occur if the world price applied without modification in the Australian market, would be at once used before the Cane Prices Board by millers to claim a better rate of profit, and by growers to obtain a better cane price. Assuming those claims to be granted, the employers in mills and on farms would apply to the Arbitration Court for increased wages." It may be mentioned that, following the new agreement, which allowed an increase to the millers for their raws, the Arbitration Court of Queensland granted an increase of wages to sugar workers. "The probable result would be that the large proportion of this temporary rise in price would go to increase the wages, cane prices, and factory and refining profits of the industry. But the basis of this improvement would be evanescent, while it has to be remembered that once wages or prices are advanced there is always opposition to their reduction. The abnormal world prices which now exist, . . . make it in the interests of stability for producers, as well as in the interests of consumers, that prices also should be controlled." This advice has been taken by the Federal and State authorities, for not only are the wages, prices for cane, raw sugar, and the refined articles fixed, but also the retail price (6d. per lb. for A1 whites).

After quoting world prices, the Commission voices the fact that the Australian consumer, then getting his sugar for 3½d. per lb. retail, was getting this article at the lowest price in the world, and claimed that this position was due "to the existence of the Australian sugar industry and to the pre-vision of the Federal authorities in making early purchases of sugar abroad to an extent sufficient to supplement the Australian crop." As showing that the Federal Government has proceeded carefully in the buying of the above sugar, on which they are losing, there are at the time of writing many parts of Australia in which it is impossible to buy white sugar in any appreciable quantity. Even Brisbane, where a refinery of the Colonial Sugar Refining Co. is situated, was only about half supplied, and the strange sight of brown sugar on the tea table was witnessed. Mackay was similarly situated. Recently, as the new crop raws are reaching the refineries, this position has been alleviated, and will disappear in a week or so, but may recur again, unless other steps are taken, ere the beginning of the 1921 crushing. MR. MASSY GREENE, the Federal Minister-in-Charge of the sugar operations of the Commonwealth, replying to a deputation of jam manufacturers, brewers and others, gave a reassuring reply regarding the future supplies for the people of Australia.

The Commission also expressed the view that "to unify the scattered functions now performed by State and Federal authorities"—a vexed question for years— . . . . . . "it is necessary to have one controlling body, having a fixed tenure. A body, consisting of three Commissioners, would . . . . . be most suitable." This was the view of the many and diversified opinions regarding the point as to whether the State or the Commonwealth should have supreme control of the industry, and on which the various parties seemed fairly divided. From the figures quoted in the earlier portion of this letter it will easily be seen that the State of Queensland is financially, at least, directly interested in the stability or otherwise of the industry and a languishing sugar industry would, in various ways, mean a considerable loss to the coffers of the State. Another glaring anomaly of the old system was the fact that the State Arbitration Court and Central Cane Prices Board—to the latter of which the growers pay a direct levy to cover its expenses—fixed the wages, labour conditions, and prices for cane, whilst the Federal Minister could fix the selling rates of the raw and the refined product. The solving of this phase of the business reflects the greatest credit on Mr. W. M. HUGHES, Federal Prime Minister, who in framing the new agreement, arranged for a Council composed of representatives of the cane growers, millers, sugar workers, and State and Federal Governments, which shall, in February of each year (i.e., at the close of each crushing season), review the price to be paid for sugar; and also provided for a conference (with the chairman of the Cane Prices Board—a District Court Judge—as chairman) of six delegates each from the U.C.G.A. and the A.S.P.A. The decisions of these bodies, however, will not affect the prices paid during the currency of the present season.

Crushing is now in full swing at most of the mills which intend working this season, and it will not now be long before a fairly good estimate will be available as to the crop to be garnered. The State Bureau's General Superintendent (Mr. EASTERBY), after a recent trip to the North, reported that the Mackay district would have a medium crop. The cane grubs were doing a deal of damage in many parts of the Cairns district, and on one large plantation, out of an estimated 12,000 tons, only 4,000 tons had been left by the grubs, four years' loss from that cause on this plantation alone being estimated at 98,000 tons. The crop is light, and the quality of the cane is not up to the high density obtained last year. The crushing at Mulgrave and Hambledon will be good; Babinda anticipates a fine crop, with the density improving; Mossman, which suffered repeatedly in cyclone, expects to crush 50,000 tons; a good crushing is anticipated at Innisfail; prospects are fair on the Johnstone River; and a medium crop is expected at Ayr. Speaking generally, Mr. EASTERBY stated that the crops above Townsville were almost all fine; below that part, however, the crops were medium to poor, so that the South would be largely responsible for the deficit in the output. He issued his usual forecast as to the crop to be crushed recently, and estimated that it would be 1,365,000 tons of cane, yielding about 160,000 tons of raws, of which 114,000 tons would be made north of Mackay and 46,000 tons in Mackay and southwards. With the New South Wales output added—the cane crop on the Richmond River alone is between 70,000 and 80,000 tons and the best for three years—he states that the estimated sugar shortage will be at least 100,000 tons, which, if consumption remains at the present rate, will have to be imported. For purposes of comparison it may be noted that last year 1,258,760 cane tons gave 161,136 tons sugar, but the density that year was the highest known in the industry here, i.e., 7·76 tons of cane yielded one ton of sugar. However, weather conditions and other circumstances are so variable in Australia, and the rainfall has been so patchy, that it may yet be found that the crop will turn out better than anticipated.

The prospects for next year are bright. The weather during the planting season has been almost invariably of the best, and the "strike" has been excellent. Besides this, the increased "heart" which has resulted from the rise in price granted, is seen in increased land planted, better mechanical methods, more manuring, and an all round energy. It is confidently expected in all quarters that next year's crop will be such as to make Australia practically independent of imports, and when it is remembered that in two months of this year the imports reached a value of almost two millions sterling, it will be seen what a gold mine this will be to us, not to mention the increased amount distributed to wage earners in handling the huge crop. In addition, the high prices ruling for many articles of commerce, (e.g. petrol and paper) have directed attention to the millions of gallons of molasses which have been literally run into the rivers and otherwise wasted, and the millions of tons of megass (as it is known here) which have been burned. If Australia has awakened to the value of her by-products in this industry, and she appears to have done so, the latter will become a valuable asset in the manufacture of wood pulp for paper. Regarding the molasses, interest was recently awakened in Queensland by a visit from Mr. GERALD LIGHTFOOT, the Chief Officer of the Commonwealth Institute of Science and Industry, which is beginning to do good work in many directions. He then asserted that Queensland's requirements in power alcohol, about 4,000,000 gallons, could be distilled from the molasses produced there, and he could see no scientific or technical difficulties in the way of this being done. He stressed the point, however, of the need for concentration of the supplies for economic production of the motor spirit, but thought that the prospects of this branch of the sugar industry were hopeful. To demonstrate the value of power alcohol, he inaugurated a gathering of those interested in motors and motor traction, to show that the engines could be "started from the cold," this difficulty having been overcome as the result of investigations by the Institute, and he claimed that it was possible even to start by the improved method engines that had been refrigerated. A number of motor cars of varying makes were then supplied with methylated spirit, rather below the normal strength, and all started easily. The engines were tested under normal conditions, and without structural alterations or even alteration of the adjustment of the carburettors. Technical experts who were present expressed themselves as well satisfied with the result, which, they said, proved that the Institute had overcome the difficulty of starting engines from the cold by reducing compression and with the assistance of priming. It had been proved that day, they said, that a single fluid start upon alcohol was possible, whereas formerly the start had to be made from petrol, with a subsequent switching over to alcohol. Truly the Australians are a wasteful nation, and if the high cost of living has done nothing more than turn their eyes to the wasted by-products of their industries—for sugar is not the only case in point—it has done much to help them on the road to further tapping the riches of their country.

The profit of the Colonial Sugar Refining Company, as disclosed in its report, for the half-year ended 31st March, after providing for interest, depreciation, and other charges, was £141,234, added to which were the dividends declared on the Fiji and New Zealand shares and securities not subject to Federal Income Tax, making a total of £159,553. A dividend of 6¼ per cent. per annum was declared (£105,625), 4s. per share bonus was granted (£32,000), and the balance (£21,428) was carried forward, making the latter total £218,371.

As anticipated in my last letter, the Australian Workers' Union lodged a claim for a new award before the Queensland Arbitration Court, and after a lengthy sitting the Court made an award to take effect from 31st May, 1920, and remain in force for a year, of which the following is a brief résumé :—Where food is supplied by the employer, the allowance has been increased to 24s.6d., 23s.6d., and 22s.6d. per week in districts 1, 2, and 3 respectively. The claim for the abolition of piecework is refused. Power is given to the Industrial Magistrate to determine all disputes, his decision to be binding on all parties, subject to an appeal to the Arbitration Court. Field workers' hours will remain at 48 per week; those for mill workers being 48 in the crushing season and 44 in the slack. Growers are urged to give preference to British workers, and the warning is repeated that if large growers persist in giving preference to coloured labour, legislation may be necessary to supplement the award. Preference to members of the A W.U. and returned soldiers is refused. The minimum hourly rate for field and mill workers is increased by 5d. per hour, and miscellaneous rates in proportion. Cane-cutting piecework rates are increased all round by 1s. per ton for crops of 9 to 10 tons per acre and over, and, below that, 1s. 2d. per ton. Employees helping to extinguish fires in cane are to be paid 3s. per hour, and 14s. 6d. per day is to be paid for lost time. Field workers shall receive an increase of 18s. per week or 4½d. per hour. Some of the salient points in the evidence and finding will be dealt with more fully in my next.

Following are the latest proclaimed wholesale prices for sugar in Brisbane :—Brewers' crystals, £50 per ton; confectioners' ditto, £49 10s.; large granulated for manufacturers, £49; fine granulated (table use), £49; soft white, £48; soft yellow, £46 10s.; tablets (56 lb. boxes), £55 12s. 6d.; ditto, in 2 lb. cartons, £58 12s. 6d. Surprise is no doubt expressed on your side of the world at the wide margin between the prices received by the growers and the mills, and that paid by the consumers. But the elucidation of this must be postponed to a later communication.

As illustrating the productivity of some of our sugar lands, the writer recently saw a photograph of a stick of cane, grown in the Ayr district of Queensland, which measured 32 ft. in length.

Brisbane, 8th October, 1920.

The Clarification of Cane Juice without Chemical Treatment.[1]

By F. W. ZERBAN,

Late Research Chemist, Louisiana Experiment Station, New Orleans.

(*Continued from page 646.*)

EFFECT OF KIESELGUHR AND OF DECOLORIZING CARBON.

The first question to be settled was whether there is any danger of inversion when kieselguhr or carbon is used on raw juices, without first reducing its natural acidity. On theoretical grounds it would be expected that there is less danger of inversion than from the sulphurous acid present in juice made by the white sugar sulphitation process, because the latter acid has a greater inverting power than the organic acids in cane juice itself. In our experiments on the problem we used "Filter-Cel," which is a specially prepared form of kieselguhr of great efficiency as a filter aid, and "Norit," which is a highly active decolorizing carbon.

A quantity of raw cane juice was boiled under a reflux condenser in the presence of ¼, ½, and 1 per cent. of kieselguhr, samples being drawn every 15 minutes and analysed. It was found the acidity of 10 c.c. of juice then was 0·1 to 0·2 c.c. less, using N/10 alkali, owing either to the presence of alkaline substances, or more probably to adsorption. If it is considered that in practice the juice would not be boiled for any length of time, but simply heated to the boiling point, or not even quite to that, then rapidly filtered and evaporated in the effects at low temperature, it becomes clear that the danger from inversion is not very great. Neverless, the glucose ratio must be carefully controlled. At any rate, the natural acidity of the juice can easily be reduced, if desired, by the addition of a small quanity of lime or other alkaline substance, in order further to lower the hydrogen ion concentration.

Similar experiments with "Norit" showed that 1 per cent. of this carbon added to raw juice reduces the acidity 0·5 to 0·6 c.c. per 10 c.c. of juice, also evidently owing to adsorption. It is therefore not surprising that the rate of inversion becomes extremely low, as soon as "Norit" is added.

Having ascertained that there is little danger from inversion in actual practice, we next made some clarification experiments in the laboratory in order to ascertain the purifying effect shown by "Filter-Cel" and "Norit" towards raw cane juice. The "Filter-Cel" was added in quantities of ¼, ½, and 1 per cent. on the weight of the mill juice, the latter brought to the boiling point, and filtered through a Buchner funnel. With 1 per cent. of "Filter-Cel" the juice passed through the funnel in 3 to 5 minutes; with ½ per cent. it required 20 to 25 minutes; and with ¼ per cent. about 3 hours. This shows how rapidly the rate of filtration increases with an increase in the quantity of "Filter-Cel." The most economical quantity would have to be determined for each particular case and factory. The filtrates were quite clear, but dark in colour; in other words the colloids were not entirely removed. Large scale factory tests (mentioned further on) have demonstrated that clarification with "Filter-Cel" alone is fully equal to sulphitation. However, we are not satisfied with a process just as good as those used; and therefore followed the "Filter-Cel" treatment by one with "Norit," at the rate of 1 per cent. on the weight of the juice.

On averaging the several results obtained, it was found that ¼ per cent. of "Filter-Cel" (one experiment only) gave a purity increase of 0·40; ½ per cent.

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[1] Editorial summary of *Louisiana Bulletin*, No. 173 of 1920.

one of 0·42; and 1 per cent. one of 0·49°. The additional increase in purity due to the use of 1 per cent. of "Norit" averaged 0·50°. The total purity increase is therefore 0·9 to 1°. These experiments again showed that there is evidently no increase in the glucose ratio, and therefore no inversion, from either "Filter-Cel" or "Norit." In fact, we note a slight average decrease, which is probably also caused by adsorption. The ash is reduced considerably by the "Filter-Cel," but not any further by "Norit." This is no doubt due to the fact that the "Norit" used in these tests had not been treated with acid before use, and therefore still contained its original 4 per cent. of soluble ash, since acid washed "Norit" undoubtedly does reduce ash. The largest reduction by both "Filter-Cel" and "Norit" is in the organic non-sugars, and here the "Norit" removes material which "Filter-Cel" does not act upon to any extent. To this latter class belong, as we have already seen, the free acids, and especially the colouring matter, which is not affected to any extent by the "Filter-Cel" treatment. The figures as a whole show very clearly that a preliminary treatment with "Filter-Cel" greatly facilitates the work of the "Norit," because the decolorizing carbon would have to remove impurities which are otherwise taken up by the "Filter-Cel." That this is actually the case, was shown in our sugar-house tests, which will now be taken up.

FACTORY TESTS WITH "FILTER-CEL" AND "NORIT."

In each of the three runs about 8 to 10 tons of juice were used, and clarified in portions of about 3000 lbs. each per clarifier. In the first two the raw juice was treated with ½ per cent. of "Filter-Cel," heated until the blanket broke, then thoroughly mixed, and sent through the press. Filtration was very rapid, and after a little pumping back the juice became perfectly clear, though still dark. It was then taken into a clarifier, mixed with 1 per cent. "Norit," reheated and refiltered (using for convenience the same press). This time the juice came out bright and almost water-white. In the third run the "Filter-Cel" was omitted, and only 1 per cent. "Norit" used directly on the raw juice. The filtration was not as good here as where the juice had been pre-treated, for obvious reasons, and the juice ran slightly milky for a while. In run 1 the syrup was directly boiled to grain; and in runs 2 and 3 it was filtered through "Norit," using 5 per cent. of this on the total solids in the syrup.

The tabulated results obtained (not reproduced here) showed that there was a slight increase in purity in each clarification, averaging 0·43°, and a considerable purity increase in the "Norit" treatment of the syrup. The purity rises in the juices would have been larger had it not been for an increase in the glucose ratios, due to slight inversion (caused by the fact that we had to work with one press). In the syrup treatment with "Norit" the glucose ratio dropped in both runs where it was used. There is noted in every case a slight decrease in the ash, and a considerable one in the organic non-sugars, including acidity, in clarification as well as in the syrup treatment. In this respect the factory tests corroborate our laboratory findings. It is also noted that when "Norit" alone was used the ash dropped about 3 per cent. In run 1 it was reduced to about 4 per cent., and in run 2 almost 10 per cent. These variations are probably partly due to varying quantities of insoluble ash introduced with the cane itself in the form of soil particles.

The reduction in organic non-sugars was 16·15 per cent. in run 1, 16·67 per cent. in run 2, and 15·75 per cent. in run 3. These figures are quite close together and agree fairly well with the 14 per cent. found in our laboratory tests. The "Norit" alone took up almost as much organic non-sugars as the "Filter-Cel" and "Norit" combined, which proves that the work done by the "Norit" can be greatly reduced by a preliminary treatment with "Filter-Cel," and that consequently the "Norit" will not have to be revivified as often as would otherwise be the case. The removal of the non-sugars would be expected to promote crystallization on the concentration of the liquor, and we found this actually to be the case.

The treatment with kieselguhr and carbon also sterilizes the juice quite effectively, as was found by Dr. N. KOPELOFF; but the most remarkable effect of the new process was noticed in the colouring matter of the various products, and in its important components, iron and polyphenols. It was found that treatment with "Filter-Cel" followed by "Norit" is much more effective in eliminating these bodies than treatment by the usual sugar-house methods of clarification. The actual quantities remaining are in many cases so small that they could be determined only approximately. It need hardly be emphasized that the colouring matters are actually removed in this process, while in the sulphitation process they are only bleached temporarily, as explained before.

One of the most remarkable observations made this year is that in all the syrups, and even in the molasses and sugars, there is less iron than can combine with the polyphenols still present; whereas last year we found an excess of iron in some of the syrups, and in all the molasses and sugars. For this reason the addition of ferric salts to this year's final products caused a darkening in the colour. The low figures for iron are easily explained, as the corroding effect of the sulphites in an acid medium which is so pronounced in the sulphitation process, is excluded in the new method.

It is very gratifying to note that at least some of the sugar planters in this State have started some factory experiments along the same lines as done at the station. We shortly mention the reports we have received from two of these factories. At the first a three days' run was made with kieselguhr alone. The average increase in purity was 0·28°, and the superintendent of the factory made the following statement: "The filtration of the juices was very easy, the boiling in the vacuum pan was a surprise to the sugar boiler, and the product was in no way inferior to sugar made by the sulphur and lime process."

At the other factory a 24-hour run was made, grinding 700 tons of cane. An average of 17·2 lbs. of "Filter-Cel" per ton of cane was added to the raw juice, beginning with 20 lbs., and gradually decreasing the quantity to 12 lbs. No lime or sulphur were used. In the first four periods the average purity rose from 73·6 to 75·8°, the acidity dropped from 1 to 0·75 c.c., and the glucose ratio from 21·2 to 20·2°. In the last four periods the purity increased from 74·5 to 75·8, the acidity fell from 1 to 0·9 c.c., and the glucose ratio only changed from 21·4 to 21·7. These results confirm our own findings. Filtration was very rapid, and the press-cake could be washed to a sucrose content of 0·25 per cent., which would mean a saving of 1 lb. of sugar per ton of cane. The manager of this factory sent us a report with a letter in which he says, "Later in the season we repeated this experiment, grinding something over 2000 tons of cane using kieselguhr and treating the syrup with "Norit," which gave us the liquor from which we abstracted first a strike of granulated sugar, and then, making grain on syrup in one of our pans, we were able to take the run-offs from the granulated sugar strike and make a strike of yellow clarified sugar. The molasses from this yellow clarified sugar was then treated with "Norit," and sold as commercial molasses at 65c. per gallon. In passing this molasses over "Norit," we made a positive rise in purity of, at least, 4° reaching 40. No lime or sulphur was used."

The fact that this molasses sold at such a good price is noteworthy. The taste is naturally different from that of molasses made by chemical processes, especially by those where sulphur is used, the well known sulphur flavour being of course entirely absent, and in other respects the flavour is modified. That would be expected, because among the non-sugars removed there are certainly some which affect the taste. This is readily seen by the practically complete absence of any odour from the clarified juice, while that made with lime and sulphur has a rank, disagreeable odour.

In brief, the results obtained so far with the new process are very encouraging, and it commends itself for thorough trials carried on for a sufficient length of time to gather complete information on its merits in actual factory practice, and to collect reliable cost data.

(*Concluded.*)

American Commerce Reports.[1]

FRENCH SUGAR PRODUCTION IN 1919 AND 1920.

According to statistics published by the Ministry of Agriculture in the *Journal Officiel* of Oct. 6, 1920, the total production of sugar in France during the season 1919-20, expressed in metric tons (2,206·6 lbs.) of refined sugar, amounted to 152,332 tons, as compared with 107,841 metric tons during the preceding year.

The acreage sown with sugar beets for the season 1920-21, however, is considerably greater than during the previous season, being 202,230 acres as compared with 163,496 acres in 1919-20.

During the past two months the chemists attached to the laboratory of the French Sugar Manufacturers' Syndicate have made analyses of sugar beets from the new crop, supplied from all parts of France. These analyses show the average sugar content of French beets of the 1920-21 crop to be 17·69 per cent., as compared with 17·57 per cent. in 1919-20 and with a 16 per cent. average for the 10 years preceding the war. Basing his estimate on the above figures, the chemist in charge of these laboratories states that French sugar production for the season 1920-21 should exceed 250,000 tons, as compared with 152,332 tons during the season just terminated.

Commenting on these figures, the French journal *Le Temps* remarks that the increase in the sowing of sugar beet is due to removal of the restrictions on trade in sugar. It estimates the increase in sugar production to be worth 400,000,000 francs, which will remain in France instead of going abroad for purchases of foreign sugar, while the resulting by-products will be a valuable asset as cattle food, etc. [Consular Report, Oct., 1920.]

PURCHASES OF SUGAR MACHINERY FOR GUADELOUPE.

During the past four or five months several sugar-mill owners of Guadeloupe have visited St. Croix, Virgin Islands, for the purpose of purchasing machinery which is said to have been available there owing to the policy of centralization being pursued at present at St. Croix which calls for replacement of machinery. One of them chartered a small schooner of about 50 tons to make several trips to bring down such material as might be purchased.

In the meantime it is stated that another sugar mill has purchased from Belgian manufacturers sugar machinery to the value of 5,000,000 francs. A representative of an American sugar-machinery house informs the consulate that the Belgians were offering delivery in two or three months, while American manufacturers require one year.—[Consular Report, August, 1920.]

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[1] Culled from "Commerce Reports," published by the Department of Commerce, Washington. In many cases these are abbreviated here.

Brevities.

The production of sugar in Italy during the year 1919-20 amounted to 170,466 metric tons, the number of factories in operation being thirty-five.

Standard muscovado, according to the definition recently pronounced by L. G. L. STEUERWALD[1] of the Java Experiment Station, is a sugar having a crystal content of 95·1 per cent., surrounded by a molasses with a sucrose purity of 37·1 per cent.

T. W. RICHARDS and H. S. DAVIS[2] recently determined the heat of combustion of a number of compounds, and the values they obtained for sucrose, methyl alcohol, and ethyl alcohol, expressed in calories (18°) per grm. of substance, were respectively : 3943 ; 5326 ; and 7101.

Owing to the high cost of industrial alcohol when methyl alcohol is used as the denaturant, the Canadian Department of Inland Revenue has authorized the addition to spirit of benzol, nitro-benzol, and pine oil. This "Grade 2" spirit may be manufactured and sold in the Dominion without restriction.

In discussing the question of indicators for use in beet sugar manufacture, E. SAILLARD[3] points out that in general phenolphthalein is preferable to litmus. When operating sulphitation, alkalinity to litmus means acidity to phenolphthalein, which condition, though causing syrups to grain more easily, involves the risk of inversion. More over, raw beet sugars made alkaline to phenolphthalein keep better during storage.

C. THOMAS[4] points out that dry sugar (sucrose) when in contact with tobacco ash is readily brought into violent decomposition by the application of a lighted match at the point of contact. This phenomenon is apparently due to the presence of ferric oxide in the tobacco ash, for it is found that sugar which has been rubbed with a piece of dry rusty iron (preferably slightly warm) can be set on fire by means of a match in the same way.

Edible syrup, H. CLAASSEN points out,[5] may be produced by spontaneously allowing the beet juice to acidify during the diffusion. After filtering, the filtered acid juice can be evaporated without excessive frothing by using a high vacuum with rapid ebullition. In order to cause sufficient inversion to prevent the crystallization of the sucrose, the syrup is heated at 104–108°C. until the proportion of sucrose has been reduced to not more than 1·5 to 1·6 times the water content.

At a lecture delivered recently before the Royal Automobile Club, London,[6] Prof. H. B. DIXON, F.R.S., said that experiments carried out by him at Manchester University on the use of alcohol as motor fuel showed that a mixture of alcohol with 20 per cent. of hexane, or of benzol, has a high ignition point, and can be used at high compressions with safety. Such a mixture starts readily in the cold, and has been demonstrated to run smoothly in an engine. If such an alcohol mixture could be used for ordinary motor transit, saving 70 to 80 per cent. of other fuel, by so much would our limited resources of petrol be husbanded for the special services in which they cannot be replaced.

In an interesting paper on the preparation of colloids, it is pointed out by H. PLAUSEN[7] that hitherto it has not been possible to grind solids to that state of fineness in which the particles are less than 0·08 mm. This is insufficiently fine ; and the great problem is to obtain dispersoids of the highest possible disperse stage from the most varied substances. This is claimed to be solved by means of the *kolloidmuhle*,[8] by means of which it is possible to obtain particles having a diameter less than 0·0001 mm. Certain substances added to the disperse medium improve the "dispersing." Such an apparatus, it is suggested, should find application in the preparation of bleaching earths, carbons, and liquid fuel, reducing the oil content of oilcakes, and in the production of colloidal medicinal preparations.

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[1] *Archief*, 1920, **28**, 794.

[2] *Journal of the American Chemical Society*, 1920, **42**, 1599-1617.

[3] *Moniteur Scientifique*, 1919, **9**, 169-173.

[4] *Chemiker Zeitung*, 1919, **43**, 747.

[5] *Chemiker Zeitung*, 1920, **44**, 443.

[6] *Chemical Trade Journal*, 1920, **67**, No. 1744, 532.

[7] *Chemiker Zeitung*, 1920, **44**, 90-92.

[8] Manufactured by the Maschinenfabrik Emil Passburg, Berlin.

Publications Received.

The Carbohydrates and Alcohol. By Samuel Rideal, D.Sc., F.I.C., and Associates. (Ballière, Tindall, and Cox, London.) 1920. Price: 12s. 6d., net.

Dr. Rideal explains in his preface that the purpose of his series of works on industrial chemistry is to give a general survey of various branches of industry, showing how chemical principles have been applied, and to what extent they have affected manufacture. This member of the series deals with Starch and its Products, Cane and Beet Sugar Manufacture, Sugar Refining, Alcohol and Fermentation, and therefore covers very considerable ground. A perusal of the book shows that, although claim can hardly be made for much originality of matter, it should nevertheless prove useful to readers who may wish to acquire a comprehensive view of these industries. In fact, this volume is a compilation comprising a very serviceable introduction to the subject. In regard to the chapters on cane and beet sugar manufacture, and on sugar refining, these have obviously been prepared by a specialist; and this section of the book forms a particularly excellent outline of our industry. Altogether the book has been written with admirable clearness, and care has been taken to include a sufficient amount of detail for the purpose in view, little space having been wasted in dealing with matters which properly do not come within the scope of such a volume. Moreover, a due amount of consideration has been devoted to the chemical principles underlying the several processes discussed, as indeed should be the case in an introductory manual of this kind; while the references to other works and periodicals, providing further information on the topics treated, are complete and up-to-date.

(1) **Exercises for the Applied Mechanics Laboratory.** By J. P. Kottcamp. (2) **Exercises in Heat.** By J. A. Randall. The Loose Leaf Laboratory Series. (John Wiley & Sons, Inc., New York.) 1920.

In 1914 we drew attention to the Loose Leaf Laboratory Manual Series,[1] particularly to the volume entitled "Technical Chemical Analysis." We have now received the above two manuals, which are of the same excellent character as that already noticed. They consist of well illustrated sheets, clipped securely together, but capable of ready separation, dealing with subjects such as: the determination of the latent heat of vaporization; the heat value of a fuel; high temperature measurement by pyrometers; study of a steam engine; steam consumption tests; brake horse-power; study of the indicator diagram; operation of a Corliss engine; study of steam pumps; and much other information of considerable value to the engineering student, and likewise of interest to the practical engineer.

Third Report of Colloid Chemistry and its General and Industrial Application. (H.M. Stationery Office, Kingsway, London, W.C.2). 1920. Price: 2s. 6d. net (unbound).

Attention was drawn at the time of publication to the first and second of these reports, [2] which have been compiled by a Committee of the Chemical Section of the British Association for the Advancement of Science, of which Prof. F. G. Donnan, F.R.S., of University College, London, is Chairman. In this third report there are a number of articles on the scientific and industrial aspects of colloids, which should be perused by all interested in the subject.

Report of the Woburn Experiment Station, 1919. By A. Augustus Voelcker, M.A., Ph.D. (Royal Agricultural Society of England, London, W.C.1). 1920. Price: 1s.

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[1] *I.S.J.*, 1914, 183.

[2] *I.S.J.*, 1919, 460.

Review of Current Technical Literature.[1]

Modern Methods of Juice Clarification (Sulphitation and Carbonatation) regarded from the Standpoint of Colloidal Chemistry. *W. H. Th. Harloff. Archief voor de Suikerindustrie in Nederlandsch-Indie, 1920, 28, No. 21, 802-824.*

De Haan,[2] Prinsen Geerligs,[3] and others, have drawn attention to the adsorbing effect of the precipitates produced in carbonatation and sulphitation towards the colloidal impurities present in cane juice; and the late Mr. Harloff in this article considered the conditions that must be fulfilled in carrying out these processes in order to raise this physical action to its maximum degree. He studied this question in regard to (1) the precipitate produced, and (2) the juice treated.

Respecting the precipitate, his opinion was that it should be as coarse-grained as possible, that is, of good crystalline structure, in order that its "porosity" may be enhanced. In order to secure this, the juice previous to commencing the precipitation should be carried out to as high a temperature as possible, and it is desirable to determine just where this maximum degree lies under different conditions of working. Precipitation, moreover, should be both copious and rapid. Undoubtedly, the great fault of cold raw juice sulphitation was that the calcium sulphite was thrown down in two stages, first, on sulphuring, and second, on heating; whereas in the hot sulphitation method[4] the whole of the calcium sulphite comes down at once, giving a more grainy, a more voluminous, and a more rapidly settling precipitate. As to the juice treated, when using decolorizing carbons a condition for securing their maximum effect is that a slight acidity should obtain. In the case of adsorption by the precipitates of calcium sulphite and calcium carbonate, it would appear that this condition should also hold at the completion of the reaction. Tests carried out in the laboratory by Mr. Harloff demonstrated the peculiar fact that the rate of the settling of the precipitate obtained in the sulphitation process was strikingly improved as the alkalinity diminished and acidity was reached. Thus, in the case of juices sulphitated to neutrality to phenolphthalein *paper*, settling was slow; to phenolphthalein *solution*, it was more rapid; and to neutral litmus paper it attained its optimum effect, being good even when an insufficient amount of lime had been previously added. It is not very difficult to see the reason of this. One knows that the so-called "slimy substances" (gums and pectins, colouring matters, etc.) are slightly acid in character; and that on adding alkali to a liquid in which they are present they pass into solution, thus causing more or less viscosity; whereas on acidifying they separate to an extent permitting them to be adsorbed by surface attraction, whether by the agency of decolorizing carbon, calcium sulphite, calcium carbonate, or any other adsorbent.

It will be clearly understood, of course, that the supreme factor in the adsorption of the colloidal impurities by the precipitate of calcium sulphite or carbonate is its quantity, which is controlled by economic considerations; and that the conditions mentioned above, viz., its granular nature, its complete and rapid separation, as well as the slightly acid reaction of the juice treated, serve only to bring this quantity within a reasonable limit. The rest of Mr. Harloff's interesting paper was devoted to considering to what extent it is possible to realize these conditions in the practical operation of the sulphitation and carbonatation processes.

Discussing first the Bach process of syrup sulphitation, it is suggested that improved results might be obtained by heating the thick-juice coming from the evaporators at once to 85°C. without at the same time sulphiting as is now customary, then liming and gassing simultaneously while maintaining a slightly acid reaction. In this way, precipitation would probably be quicker than in the more strongly acid medium now used. In regard to the ordinary raw juice sulphitation process, since the old "cold" method is theoretically incorrect, the so-called "hot" process need only be considered. It has already been much improved by raising the temperature of the preliminary heating from 60 to 80°, and even to 85°C., and it would be desirable to ascertain whether this degree might not be carried yet higher. Moreover, the final reaction should be slightly acid, in order to facilitate the subsiding of the juice; and indeed it might be possible by thus inducing the absorption of the "slimy substances" to obtain juices capable of filtration, realizing thus the greater clarifying effect so far given only by carbonatation combined with the lower cost of the sulphitation method. There would probably be little danger in heating to boiling point juices having a reaction approaching litmus neutrality (in reality a slight acidity), provided this were done as quickly as possible. Again, filtration through cloth might be made feasible by the use of more lime in conjunction with the higher preliminary temperature and the slightly acid final reaction. It does not appear clear why it should be better in using the Bach process to lime the juice and the syrup separately, instead of adding at once to the juice the total quantity of lime used in both operations, especially in view of the better mechanical effect now obtainable by the hot sulphitation method of sulphiting the raw juices. It might be possible thus to filter the entire juice. Another point of importance for the rapid and complete separation of the sulphite precipitate is that it is necessary for the SO_2 content of the sulphur-oven gas to be as high as possible, and there are a number of factories in Java in which this figure is as low as 10 per cent. It will never be practicable to realize filtration of the whole juice in the sulphitation process with such badly controlled sulphur oven gases.

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[1] This Review is copyright, and no part of it may be reproduced without permission.—(Editor, *I.S.J.*)

[2] *Archief*, 1917, 508.

[3] "Practical White Sugar Manufacture," pp. 62-63.

[4] *I.S.J.*, 1920, 351.

Coming lastly to the carbonatation process, it was remarked that formerly gassing was performed almost in the cold, but that by raising the temperature to 55°C., and in this way obtaining a quicker precipitation, and a more grainy calcium carbonate, such a great improvement was effected that 40 per cent. of the lime originally used had been saved. It may be found possible yet further to raise the temperature of the juice before commencing the formation of the precipitate in it, perhaps to 85°C., the lime being reduced at the same time. Concluding Mr. HARLOFF said that had he been in practice in Java at the present time he would have advocated and tested the following modification of the single carbonatation process: preliminary temperature of the raw juice, 85°C., liming and gassing, as ordinarily; alkalinity after carbonating, 200 mgrms. of CaO per litre to phenolphthalein; neutralization with sulphur dioxide, using phenolphthalein indicator; and final temperature of heating, 85°C., or higher.

ENTRAINMENT AND DECOMPOSITION OF JUICE DURING BOILING IN EVAPORATORS AS AN EXPLANATION OF UNKNOWN LOSSES.

(1) ***A. Schweizer.*** *Archief voor de Suikerindustrie in Nederlandsch-Indië, 1919, 27, 2010-2013.* (2) ***J. G. van Ham.*** *Ibid., 1919, 27, 2098-2100.* (3) ***F. G. E. Olsen.*** *Ibid., 1920, 28, 223-271.*

(1) On several occasions when investigating the cause of high unknown losses, occurring suddenly in factories in which otherwise the sugar account is normal, Mr. SCHWEIZER has been forced to the conclusion that destruction of sucrose must have occurred during evaporation; and he draws attention to the interesting experiments of ABELOUS and ALOY[1] on the inversion of sucrose by the mechanical ionization of water. These French investigators showed that if 100 c.c. of a 5 per cent. solution of sucrose were passed 5 times through a Richardson vaporizer (or "atomizer") about 0·06 grm. of invert sugar resulted, the amount being sensibly increased by the presence of electrolytes (such as one finds in the Ringer-Locke reagent[2]), and still more by traces of zinc and manganese sulphates. Mr. SCHWEIZER, therefore suggests that the juice entrained in an evaporator is capable of being dispersed or "atomized" by the rapidity of the current of vapour, and that in this form it is subject to decomposition, not only to the stage of inversion, but even to complete degredation with the production of carbon dioxide

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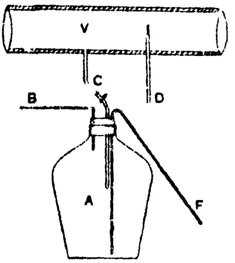
[1] *Comptes rendus*, 1919, **168**, 1125-1128.

[2] This solution contains 6·5—9·5 grm. of sodium chloride; 0·2 grm. of potassium chloride; 0·2—0·3 of calcium chloride; and 0·1 grm. of sodium bicarbonate in a litre. *Cf*, *Journal of Physiology*, 1895, **18**, 318.

and water. He believes that it would be of value to investigate the possibility of the sugar present in the juice in this way while it is under the influence of a vacuum, heat, and non-sugars. It is likely that free sulphurous acid (which may be present in the evaporators, pans, and vapour pipes in white sugar factories) may be found to play a great rôle as a catalyst. It may thus be possible to explain why it is that often no reaction for sugar is indicated in the waste-waters, when by the weighing of the thick-juice and by its careful analysis, losses are known to be taking place, and when also the reaction re-appears immediately some sugar solution (e.g., molasses) is introduced into the injection water. It is noticeable moreover that these unknown losses are particularly pronounced when dealing with poor juices, such as those obtained by crushing burnt or unripe cane.

(2) Mr. van Ham expresses agreement with the view stated above. He points out that in the central vapour pipe the speed of the steam is 60-120 metres per sec., depending upon the vacuum and the volume. Such a hurricane velocity must be capable of exerting a greater or less influence on the juice spurting up during boiling, and it would almost seem certain that it would become "atomized" in this way. Moreover, while whirling through the bends of the vapour pipes, the kinetic energy of the steam would be converted into heat; and the lowering of the pressure of the steam at different points would likewise result in the production of heat. It should be easy to examine the question in the laboratory by boiling a sugar solution in a flask connected to a vacuum apparatus by bent tubing, imitating factory conditions as closely as possible in this way.

(3) Mr. Olsen is also of the view that high losses of sugar are capable of occurring during evaporation, and he describes experiments which he considers prove conclusively that sugar is (*a*) entrained, (*b*) inverted, and (*c*) entirely decomposed, thus appearing fully to substantiate Schweizer's theory. He used the sampling apparatus shown in the sketch, consisting of a large vessel *A*, holding about 50 litres (11 Imp. gall.), which was connected either by pipe *C* or by pipe *D* (generally the former) with vapour line *V* of the evaporator. Tube *B* was attached to an air pump in order to draw steam and liquid into the vessel *A*; while syphon *F* was employed to draw off the liquid collecting in the vessel *A* for its examination for Brix, sucrose, reducing sugars, and acidity. Two of these apparatus were used in the case of the third compartment of the triple effect, the first being placed just before the Hodek juice-catcher, and the other between the Hodek and the condenser. It was then found that, whereas in the first apparatus a comparatively considerable amount of sugar could be collected, there appeared to be very little passing into the second, a minus polarization being sometimes shown. This was concluded to indicate: (*a*) that entrainment was taking place, and (*b*) that later this entrained sugar was inverted. At the same time, continuous tests were made of the condenser waters, using both naphthol and Fehling's solution, but always with negative results, which appeared further to prove (*c*) that decomposition of the entrained sugar had occurred after the steam had left the Hodek *ralentisseur*. It is worth noting that all the samples collected in the two apparatus were strongly acid, though in this particular factory sulphitation of the juices had not been applied. It was impossible from the tests made to estimate how much sugar had been lost in this way; but assuming that it is about 1 per cent. of the sucrose introduced into the evaporators, this surely amounts at the end of the season to a serious figure, making the study of means of preventing the entrainment and subsequent decomposition very well worth while. Lastly, an observation from Claassen's book[1] is quoted, in which it is said that if water drained from any part of the vapour pipe of the evaporator does not respond to the test for sugar "it may be assumed with confidence that any sugar loss must be exceedingly small." This assertion now appears untrue in the light of these experiments, which certainly seem to demonstrate that it is possible to have entrainment losses without sugar being found in the waste waters.



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[1] "Die Zuckerfabrikation," third edition, pages 140 and 142.

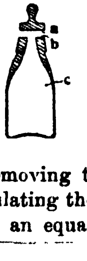
INSTALLATION OF BATTELLE'S PLANTATION WHITE SUGAR PROCESS IN THE CENTRAL JOVERO, DOMINICAN REPUBLIC. *Anon.* *New York Record, October 8th, 1920.*

A large factory to be known as the Central Jovero is being erected at Samana Bay, Dominican Republic, by the Honolulu Iron Works for the American Dominican Sugar Co., of New York, the capacity of this plant being 1500- 2000 tons per day. It is of interest to note that the Battelle process for the manufacture of a plantation white sugar (quite equal in quality to the "standard granulated" of the American beet factories) will be employed. This process, it will be remembered,[1] consists briefly in boiling the cane juice with an excess of lime (the "glucose" thus being destroyed), and applying the carbonatation process, after which the light-coloured juice obtained is concentrated and boiled to grain in the usual way. A feature of this method of working is that the sugar ordinarily lost in the molasses is recovered by means of the Steffen process, an increased recovery of about 5 per cent. being thus obtained.

Mr. E. ERLE BATTELLE (who will be in charge of the El Jovero plant) is reported as having stated that: "It is understood the cane contractor will deliver not less than 200,000 short tons of cane per year to our mill by ox carts or loaded into our railroad cars at sidings. The yield of sugar will not be less than 12 per cent. or 24,000 tons per year of granulated sugar, of which 12,000 tons (50 per cent.) will be delivered to the cane contractor as his portion of the product and as full payment of his delivered cane, and the remainder of 12,000 tons granulated sugar to be our share of the product. The estimated costs and charges, including labour, packages, supplies, railroad operation and repairs, repairs equipment, administration costs, and fixed charges and depreciation should be 1·5911 cents per lb. sugar produced and 3·1822 cents gross per lb. cost to us. This outside cost for our granulated sugar, before dividends, of 3·1822 cents f a s. will permit us to deliver, duty free, at Atlantic ports of the United States at the additional cost of 0·4579 cents for insurance and freight and 1·36 for full U.S. duty, or a total cost on the American market of 5 cents per lb."

PYCNOMETER FOR THE DETERMINATION OF THE DENSITY OF MOLASSES. *W. B Newkirk.* *Technologic Paper No. 161, Bureau of Standards, Washington, D.C., U.S.A., 1920.*

Further details are now available since the publication of the preliminary notice of this Paper.[2] Removal of the included and dissolved gases were found to be best accomplished by the use of a vacuum, using the improved pycnometer shown in the illustration. It consists of a bottle *C*, fitted with an enlargement at the top *B*, ground optically flat, and closed off by another optically flat piece *A*. An expansion chamber *D*, is ground to the bottle, and fitted with a vacuum connexion *E*. To avoid loss of water due to evaporation under the reducing pressure, the connecting tube is fitted with a stopcock *F*, so that when the proper vacuum has been reached the apparatus can be closed off from its source, the amount of water evaporated being negligible. In using the pycnometer, the expansion chamber is connected to bottle after lubricating all joints with molasses, and the molasses to be analysed is allowed to flow into the expansion chamber until about one-third full. By connecting with the vacuum line, the pressure is reduced until the gas expands to visible bubbles, when the apparatus is immediately closed by turning the stopcock *F*, the whole apparatus being placed in the thermostat for accurate work, or in the balance case for ordinary control tests. When all the bubbles have collected in the expansion chamber, and the temperature has reached equilibrium, the volume is fixed by means of the flat piece *A* after removing the expansion chamber. Finally, the bottle is wiped, and weighed. In calculating the results, the weights are corrected to vacuo and compared with the weight of an equal volume of water at 4°C., in vacuo. They are reported in degrees Brix.[3]



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[1] See *I.S J.*, 1912, 163; 1913, 47, 535; 1914, 181, 484; 1915, 357; 1919, 577.

[2] *I.S J.*, 1920, 523.

[3] Tables are given in *Circular 44, Bureau of Standards.*

It was proved that the use of heat for the elimination of the dissolved gases resulted in a low Brix being obtained, owing to considerable decomposition of an unknown character, the values found being (a) 76·41° directly after filling, and without heating or exhausting; (b) 76·91° after standing full for 24 hours without heating or exhausting; (c) 76·96 after exhausting, but without heating; and (d) 76·66 after heating at 80° C. for two hours. It is clear, therefore, that the aid of heat should not be employed. Results are also given showing good reproducibility, the individual accidental error being within 0·1° Brix, while the general run of determinations check to within a few hundredths of a degree.

DISTILLATION AND RECTIFICATION (OF ALCOHOL). *L. Gay.* *Chimie et Industrie, 1920, 4, No. 2, 178-188.*

Equations are given for the calculation of the composition of the liquid and vapour phases in the case of a mixture of two constituents, and for determining the minimum amount of heat necessary. In the case of aqueous-alcoholic solutions, if the strength exceeds 8·2 per cent. by weight of alcohol, the heat required varies little with the concentration of the solution, and ranges from 900,000 to 1,000,000 calories per 1000 kg. of 95° alcohol recovered. With these solutions the height of the rectifying column may be kept unaltered with a theoretical minimum of 25 sections. As the alcohol content decreases from 8·2 per cent., the rectification column should be correspondingly reduced until at 3·7 per cent. its length will be two-thirds of that of the distillation column.

EFFECT OF DECOLORIZING CARBON ("NORIT") IN THE REMOVAL OF CERTAIN NITROGENOUS AND OTHER SUBSTANCES FROM SOLUTION, AND ITS POWER OF ELIMINATING BACTERIA. *Joseph C. Bock.* *Journal of the American Chemical Society*, 1920, *42*, No. 8, 1564-1569. (Contribution from Department of Physiological Chemistry, Marquette School of Medicine, Wisconsin, U.S.A.)

It is pointed out that studies on decolorizing carbons have generally dealt with its capacity for adsorbing colouring matters from solution, there being comparatively few attempts recorded in connexion with its power of taking up other substances. In one case of urine, "Norit" was found to remove uric acid completely; creatinine very largely; urea, solid nitrogen and phosphates considerably; and ammonia-nitrogen, chlorides, and dextrose (glucose) only slightly. It also adsorbed lactose from milk to a slight extent, and proteins from blood quantitatively. When second solubles are present, each one is adsorbed less than when present separately. Adsorption from solution is specific and delective, which unfortunately at present only means that we are ignorant of relations which undoubtedly do exist between the degree of adsorption on the one hand, and the physical and chemical properties of adsorbent and adsorbed substance on the other. BOUILLON cultures of two organisms when shaken with "Norit" for a few seconds and allowed to stand for three or four minutes, caused a marked decrease in the bacterial count; and it may be possible (as one observer has claimed) to effect complete sterilization of liquids in this way. On washing a sample of "Norit," its ash content was reduced from 5·13 to 2·18 per cent., and its decolorizing power was thereby increased.

PREPARATION OF AMMONIA-FREE WATER. *Gerard C. Baker.* *Journal of Industrial and Engineering Chemistry, 1920, 12, 798-799.*

Water free of traces of ammonia (which is required in water analysis in the determination of the free and combined ammonia and "albuminoid ammonia") may be prepared easily by permitting ordinary distilled water to flow slowly through a filter of "permutit" (a synthetic hydrated silicate of sodium and aluminium). In the case of distilled water containing 0·7 part of ammonia per million, 100 gallons of ammonia-free water were obtained with the use of a filter containing 3 gall. of the "permutit," which was subsequently regenerated by treatment overnight with 2 gall. of a 10 per cent. solution of common salt. However, the nitrate and albuminoid ammonia were not removed by this treatment, and its mineral content was increased.

CHANGES IN THE POLARIZING CONSTANTS OF CANE SUGARS DURING REFINING.

A. F. Blake. *Paper read before the Sugar Section of the American Chemical Society, September, 1920; Journal of Industrial and Engineering Chemistry, 1920, 12, No. 11, 1104-1107.*

Dr. BROWNE has pointed out [1] that if the percentage of dextrose and levulose in cane products is approximately equal, the CLERGET value of the sucrose (*S*) will exceed the polarization (*P*) by about ⅓ the invert sugar (*I*), the readings being made at 20° C. While this is true for raw sugar, Mr. BLAKE shows that in the products of a refinery (soft sugars and syrup), the value of the ratio $(S—P)/I$ is very low. Analyses of products at all stages of refining were made; and it is concluded that although some change takes place during defecation due to the action of the lime on the invert sugar, the principal cause of the reduction of the value is the boneblack filtration. In fact in the case of the first liquors coming off the char, the factor is strongly negative, increasing in following portions until in the last it equals or slightly exceeds that of the product going on. It was found that the average value of the factor for all the material going on the char is much higher than the average of that coming off. Sinc boneblack absorbs invert from the first materials and gives it up to the later liquors, it was supposed that by selective action it might absorb more levulose than dextrose. This was proved to be so by tests on invert sugar. Another suggested cause of the change is the molecular rearrangement of dextrose and levulose into dextrose, mannose, etc.

INFLUENCE OF ATMOSPHERIC CARBON DIOXIDE ON ALKALIMETRIC TITRATIONS.

G. Bruhns. *Zeitschrift für die Zuckerindustrie in Czecho-Slovakia, 1920, 44, 331-335.*

When approximately N/100 sodium hydroxide solution is titrated with N/100 hydrochloric acid, using phenolphthalein as indicator, less of the acid (sometimes amounting to 10 per cent. by volume) is required than is the case when methyl orange is employed. This is due to adsorption of carbon dioxide from the air during the titration, which effect may be avoided (for example, in the determination of the alkalinity of syrups) by reversing the procedure, and adding the alkaline solution to the standard acid.

RAPID METHOD OF ASCERTAINING THE AMOUNT OF LIME REQUIRED FOR CLARIFICATION.

Manuel L. Roxas. *Sugar News, 1920, 1, No. 10, 13-14* and *29.*

Instead of titrating with N/10 alkali, the concentration of the standard solution chosen is preferably such that if a definite volume of juice be taken for the acidity determination, the volume of a solution of milk-of-lime of definite calcium oxide (CaO) content required for the clarification of one tankful of given volume will be directly the number of c.c. observed. Assuming v to be the c c. observed on titration; y, the normality of the standard alkali; a, the volume of juice taken for the analysis; b, the weight of calcium oxide required for clarification; x, the volume of the milk-of-lime in litres, containing b kg. of calcium oxide; c, the concentration of calcium oxide in the milk, per cent.; and d, the volume of the tank used for measuring the juice in litres, then (1) $\frac{v}{a}\, y\, \frac{0{\cdot}056}{2}\, d = b$; (2) $\frac{c}{100}\, x = b$; (3) $v = x$; and $y\, \frac{v \times 2 \times c}{0{\cdot}056 \times d \times 100}$. With d of definite value, v and c should be chosen so that y is between N/5 and N/15. Thus, for example, if d is 3788 litres (1000 U. S. gall.); v is 50; and c is 20 per cent., then $y = \frac{50 \times 2 \times 20}{0{\cdot}056 \times d \times 100} = 0{\cdot}0943$ N. Assuming the volume of the measuring tank to be 3888 litres (or 1000 gall.), pipette 50 c c. of the mixed juice; add three or four drops of phenolphthalein, and titrate with the alkali solution to the appearance of a noticeable pink colour. If the milk has been made to contain 20 kilos. of calcium oxide per 100 litres, the number of litres needed for the clarification will be directly the number of c.c. of the 0·0943 N alkali solution used in titration.

J. P. O.

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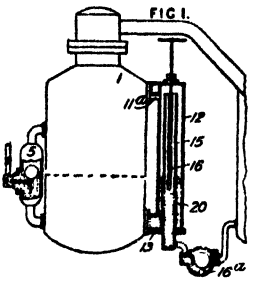
[1] *I.S.J.*, 1919, 38-39.

Review of Recent Patents.[1]

UNITED KINGDOM.

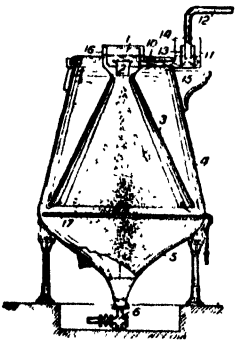
Evaporator Level Control. *Griscom-Russell Co.*, of New York. *146,730 (18,718).* July 28th, 1919; July 15th, 1920. (Three figures.)



As is shown in the figure, the levels in the evaporators of a multiple effect or other apparatus are maintained by controlling the flow of liquid from one evaporator *1* to the next by causing it to overflow through a narrow slot *16* or its equivalent in a wall *15* arranged in the discharge line *13*. The level in the first evaporator *1* is maintained by a float-feed device *5*. The wall *15* consists of a stand-pipe arranged in a chamber *12* which communicates with the evaporator *1* by a pressure-equalizing pipe *11*^{a}. The overflow level is adjusted by a sliding sleeve *20*. A steam trap *16*^{a} or a check valve closes the connexion in the event of the overflow ceasing owing to failure of feed, &c. In the event of excessive feed, the liquid rises in the chamber *12* and eventually overflows the top of the stand-pipe *15*. A series of vertically-arranged perforations may take the place of the narrow slot *16*.

Separation of Mud by Settling. *J. Denoël*, of Yvoz-Ramet, Liège, Belgium. *149,551. (25,206).* October 14th, 1919; October 19th, 1920.

In the subsiding apparatus described, separation takes place as the muddy liquid flows down a funnel, the precipitate being withdrawn continuously at the bottom of the apparatus, while the purified liquid flows upwards through an outer casing, so shaped that the liquid substantially maintains the velocity with which it leaves the funnel, as is seen in the figure. The liquid enters the funnel *3* through a pipe *2* from a box *1*, the walls of the funnel being prolonged upwards as at *16* to facilitate the escape of air. The funnel *3* is surrounded by a casing, the upper part *4* of which is so shaped that the cross-section of the space between it and the funnel *3* is substantially constant, so that the velocity of the liquid flowing upwards through it is maintained substantially unchanged. The lower part *5* of the casing is preferably bell-shaped as shown, to hinder the solid matters, which are withdrawn continuously through the outlet *6*, from adhering in the walls. Liquid enters the apparatus by a pipe *12* opening into a tank *11* containing a baffle *13* and communicating with the box *1* by a pipe *10*. The tank *11* has a perforated cover *14* through which froth can overflow into the receptacle *15*. A sprinkler pipe *17* is provided for rinsing the bottom part *5* of the casing.



Machine for Cutting Oranges, etc. *Archibald W. Maconochie*, of Millwall, London, E. 14. *148,030 (14,420).* June 6th, 1919; July 29th, 1920. (Six figures.)

The fruit is fed to a moving table adapted to receive it in separate or individual order to present it to the vertical and horizontal cutting devices. After being operated upon by the latter, the cut pieces are carried to a point where they are discharged into a suitable receptacle. The feeding to the table may be done by means of a suitable hopper arranged relatively to the table; while the cutting is effected by the horizontally and vertically disposed knives, the arrangement being such that the fruit is subjected to a vertical cutting and a horizontal cutting, so that it is divided into quarters.

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[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States:* Commissioner of Patents, Washington, D C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 2fr. 00 each).

Starch Manufacture. *Reckitt & Sons, Ltd., and Charles H. Hardy*, both of Hull. *147,255* (*8741*). April 7th, 1919; July 7th, 1920.

Rice starch free from soluble salts is made by the following successive steps: (1) Steeping in cold or luke-warm water; (2) fine grinding until 95 per cent. passes through a 130 × 130 mesh silk water being added during the operation until the mass contains 30 to 40 per cent. of solids; (3) further diluting to 18 to 25° Tw. (1090 to 1125 sp. gr.) for centrifugal separation, or to 1·5 to 2° Tw. (1007·5 to 1010 sp. gr.) for decantation; and (4) settling out the residuals.

Boiling Pans used in Confectionery Manufacture. *Robert S. McColl, Thos. N. McColl, and Thos. F. Dryden*, of Glasgow. *149,172* (*30,772*). December 9th, 1919; August 12th, 1920. (Two figures.)

A plurality of boiling pans (hitherto operated separately) are grouped in a row to constitute a bench (or twin-bench), the pans proper being immersible in water contained in a vat common to a number of pans, into which vat steam may be injected directly or through coils for heating, there being also provided driving mechanism for the stirring devices including an overhead line shaft common to each row.

Preparation of Pure Starch for the Manufacture of Starch Glucose. *Adolph W. H. Lenders*, of Cedar Rapids, Iowa, U.S.A. *149,374* (*5512*). March 5th, 1919; August 12th, 1920.

Starch made in the ordinary way from maize by steeping, breaking the kernel, removing the germ, and "tabling," invariably contains 0·5 to 1·0 per cent. of protein matter, which during the subsequent hydrolysis results in the discoloration of the converted liquor, necessitating char filtration, and also (it is stated), causing a more or less bitter taste. It is now proposed to eliminate this impurity of the starch by the action of proteolytic bacteria.

Indian corn starch is mixed with warm water to a density of about 21° Bé. (37·5Brix.) to give a temperature of 100 to 105°F. (38-41°C.) and the liquor inoculated with a number of the *Bacillus putrificus* group, the particular organism best calculated to serve the purpose being B. No. 121, 1233111, in accordance with the descriptive chart of the Society of American Bacteriologists endorsed for general use in 1907. About 2,000,000 bacteria per c.c. should be present. After the inoculation the suspension is stirred for about two hours, allowed to stand for 20 hours, and the char liquor drawn off. Fresh water is then added, after which stirring, settling, decanting and the addition of water again follow. These operations are repeated daily from 6 to 12 days according to the amount of protein matter remaining, and finally after the last decantation the starch is washed well with water. In order to make glucose from this pure starch it is mixed with water to give a density of 10° Bé. (17·7°Brix), acidified with hydrochloric acid, converted at 20 lbs. pressure per sq. in., cooled, neutralized, and filtered, with the aid of kieselguhr. It is subsequently concentrated in a vacuum pan to 42° Bé. (77·8°Brix), which liquor may be cast in moulds and allowed to crystallize. It is, however, preferable to heat the liquor at a temperature of 145° F. (63° C.) while adding seed crystals, this heating operation being carried on with the material in contact with the atmosphere so that the product is cooled. When in a frothy porous state, it is run into mould pans in which it will crystallize in a few hours, instead of days as formerly, forming a hard but porous body which may be ground to a fine powder. It is to be noted that the entire yield can be crystallized, and that the use of boneblack (char) is unnecessary for the production of a high-grade material.

CANE MILL. *F. J. de Bruin*, of Rotterdam, Holland. *149,289* (*21,403*). July 15th, 1920; convention date, 1919; *not yet accepted; abridged as open to inspection under Section 91 of the Act.*[1]

In a 3-roller mill mounted in triangular arrangement with hydraulic pressure on the top roller, the back roller is arranged to maintain the size of the back opening in accordance with the thickness of the layer of cane in the opening for the purpose of causing a regular pressure in the inlet and outlet openings of the mill. The back roller may be movable in any radial direction and be fitted with hydraulic means. The top and back roller trunnions and the mill housings have flat and slightly concave sliding faces. The top roller is loaded vertically or in any oblique direction, as at an angle of 90° to the connecting line between the top and back rollers, and the hydraulic means on the back roller acts in an horizontal direction or in any other direction, as in the direction of the back pressure.

MOTOR FUEL CONTAINING ALCOHOL.[2] *United States Industrial Alcohol Co.*, of New York. *149,398* (*11,420*). May 7th, 1919.

A fuel consisting of dehydrated alcohol, one or more light hydrocarbons, such as gasolene or kerosene, and acetylene, is obtained by adding a mixture of alcohol and hydrocarbon to excess of calcium carbide, or by adding alcohol only to the carbide and passing the acetylene evolved into the hydrocarbon and afterwards mixing the two liquids. Acetone saturated with acetylene may be added.

METHOD OF EVAPORATION, EMPLOYING THERMO-COMPRESSION. *Metallbank und Metallurgische Akt. Ges.* of Frankfurt, Germany. *140,059* (*3896*). February 9th, 1920; convention date, March 13th, 1919; September 9th, 1920. (One figure.)

This invention is based on the recognition that the cause of the incomplete condensation of the hot vapour which has been compressed and returned to a heating system is less attributable to the heating surface of the apparatus than to the presence of air (which in practice can never be avoided). According, however, to the specification the whole or part of the heat lost in the uncondensed portion of the compressed heating vapour is replaced by utilizing its heat as a supplementary evaporating agent by passing it into direct contact with the liquid to be condensed, or by uniting it with the evaporated hot vapours prior to compression. The essential feature of the invention consists in that an amount of heat sufficient for evaporation is made available by the vapour compressor circulating an amount of vapour which is greater than that generated in the evaporator. This is effected by connecting the outlet chamber of the heating tube system of the evaporator with the evaporating chamber of an evaporator, or with the suction pipe of the compressor by means of a pipe suitably provided with a closing means adapted to modify its sectional area. The result thus obtained is that the volume of vapour passed through the heating-tube system need not be completely condensed and that the required heating effect is attained, in spite of the presence of air.

PRODUCTION OF ALCOHOL. *A. Meyer*, of Rotterdam, Holland. *144,244* (*28,594*). November 18th, 1919; convention date, May 31st, 1919; *not yet accepted.*

Fermentation for the production of alcohol and yeast is carried out in closed vessels under reduced pressure, the evolved carbon dioxide being cooled and led through water to recover the alcohol.

LINING FOR CENTRIFUGAL MACHINES.[3] *S. S. Hepworth Co.* (Assignees of *E. D. Mackintosh*), of New York. *143,902* (*14,552*). May 28th, 1920; convention date, July 19th, 1918; *not yet accepted;* abridged as open to inspection under Section 91 of the Act.

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[1] Further particulars of this invention (with illustrations) will be given as soon as the complete specification is published. [2] See also *I.S.J.*, 1919, 528; 1920, 236, 477, 592.

[3] See U.S. Patent, 1,313, 227; *I.S.J.*, 1920, 115.

SACCHARIFICATION OF CELLULOSE. *A. Wohl*, of Langfuhr, Dantzig, Germany. *146,860 (18,744)*. July 5th, 1920; convention date, April 7th, 1917; *not yet accepted;* abridged as open to inspection under Section 91 of the Act.

The quantity of concentrated mineral acid such as hydrochloric or sulphuric acid necessary to saccharify materials containing cellulose is reduced by carrying out the reaction under "mechanical pressure" while keeping the materials mixed, for example in a mixer of the type used in brickmaking.

UNITED STATES.

CANE MILL COMBINED WITH TWO CRUSHERS. *Henry Hurter* (Assignor to the *Fulton Iron Works Co.*), of St. Louis, Missouri, U.S.A. *1,339,600* (serial *297,652*). May 16th, 1919; May 11th, 1920. (Five figures.)

This invention has as its object to grind a maximum tonnage of cane with the highest possible extraction of juice at a minimum operating cost. It comprises a primary crusher, having rolls provided with relatively large peripheral ribs whereby the mass of cane is subjected to a preliminary crushing to prepare it for the second crusher having smaller ribs of less pitch than those of the primary crusher. From this second crusher the cane preferably passes to a first 3-roller mill with relatively small ribs of less pitch than those of the second crusher; and after being acted upon by these ribs, the cane passes to a second 3-roller mill having still finer ribs; and thence through a series of 3-roller mills having ribs which preferably correspond approximately to the fine ribs of the second 3-roller mill.

Referring to the illustration, as shown in Fig. 1, the ribs of the first crusher are peripheral and preferably V-shaped in cross-section, and the ribs of one roll overlap those of the other, the ribs of each roll being extended into the corresponding peripheral grooves formed in the other roll. In the second crusher, the ribs correspond approximately in shape with those of the first, but are preferably of less pitch, and are smaller than the ribs of the first, besides which the co-operating ribs are preferably located relatively close to each other, as shown in Fig. 2. All three rolls of the first 3-roller mill are provided with ribs, which are finer than the corresponding ones of the second crusher, as may be seen from Fig. 3. Regarding the second, third, fourth, and fifth 3-roller mills, all three of each are provided with peripheral ribs, as shown in Fig. 4, which are smaller and of less pitch than the ribs of the first mill. Experience proves that greatly improved results can be obtained by making the pitch of the ribs of the first and second crushers 3¼ and 2¼ in. respectively; of the first mill, 1 in.; and of the remaining mills, ½ in.; but the invention is not limited to the use of these dimensions. The large ribs of the first crusher are adapted to mash and compress the cane; those of the second to split and shred, after which it is in a form best suited for the crushing and expressing functions of the 3-roller mills. The rolls of the second 3-roller mill are preferably closer to each other than the corresponding ones of the first mill; while those of the third, fourth, and fifth are closer than in the case of the second 3-roller mill The ribs of the second 3-roller mill are found by actual experience to be far superior to the larger ones of the first 3-roller mill in expressing the juice from the prepared mat of cane, and fine teeth of this kind are well adapted to perform the subsequent extracting operations in the third, fourth, and fifth 3-roller mills.

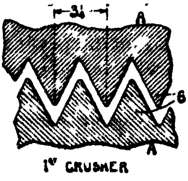


FIG. 1.

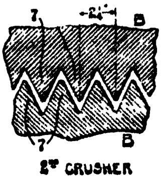


FIG. 2

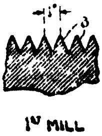


FIG 3

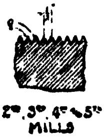
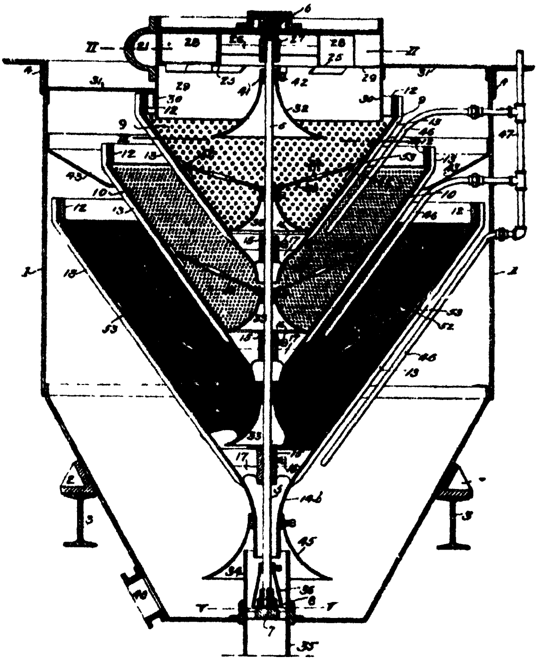
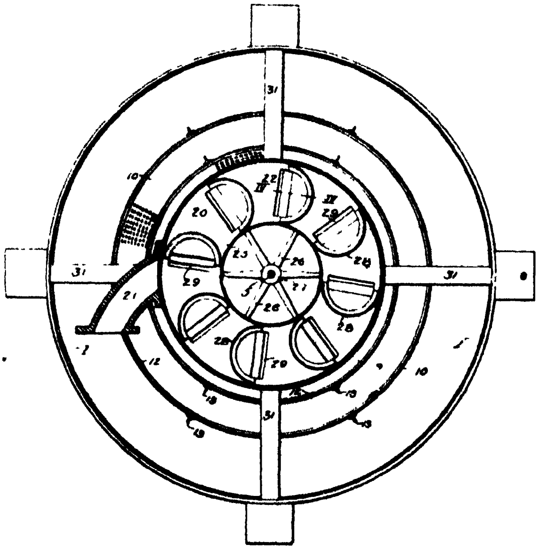


FIG 4

STRAINER FOR CANE JUICE. *Martin E. Carter*, of Philadelphia, Pa., U.S.A. *1,343,078.* August 16th, 1916; renewed, February 7th, 1919; patented, June 8th, 1920. (Five figures.)





Centrally disposed with respect to the casing *1* and the screens is a shaft *5*, having a ball-bearing *6* suitably mounted at the upper end of the structure, and a step bearing *7*, with an interposed ball race *8*, at the bottom of the casing. Within this casing are a plurality of funnel-shaped strainers or screens *9*, *10* and *11*, of suitable foraminous or reticulated material, which may be perforated plates or wire gauze, and these strainers or screens are preferably progressively finer from top to bottom of the structure. Each of the strainers or screens includes an annular ring *12* at the top, to which ribs *13* may be secured externally of the strainer or screen; the lower ends of these ribs being connected to tubular members *14*, *14*ª and *14*ᵇ respectively, forming discharge outlets for the screens; each of the tubular outlets having hubs *15* whereby they may be secured to the shaft *5* by set screws *16*, the hubs having bracing arms or spokes *17* connecting them with the members *14*.

At the upper portion of the structure, a casing *20* is provided, to which the juice may be delivered from an inlet opening *21*. Within the chamber *22* formed by this casing is a turbine structure secured to the shaft *5* whereby the entering juice may drive the shaft and the screens or strainers carried thereby. This turbine structure may comprise a suitable plate *25*, supported by arms *26*, carried by a hub *27*, secured to the shaft *5*, and having a plurality of buckets *28*. The plate *25* is apertured at *29* directly adjacent to each bucket, so that the juice may drop away from the plate as well as discharge from the outer edge of the plate against the wall of the casing *20*. The casing *20* is provided with a depending flange or guard *30*, which may be stayed and held in proper position by means of braces *31* interposed between the same and the casing wall *1*, this guard insuring discharge of all the entering juice into the screen or strainer *9*.

Carried by the shaft *5*, directly below the turbine structure, is a conical deflector *32*, so disposed that any juice dropping from the chamber *22* toward the centre of rotation will be thrown toward the screen. At the lower part of the screen, a second deflector *33* is mounted, substantially closing the bottom of the screen except for a narrow annular outlet, which deflector serves to guide the juice toward the screen preventing as much as possible from entering the tubular outlet member *14*, with the separated dirt. Any dirt separated or strained from the juice by the screen will pass down the walls of the same and through the open mouths of the outlet members *14*, 14^{a} or 14^{b} of the screens into the succeeding screen where it may be subjected to further screening action, and so on until it empties from the lower screen 14^{b} into a pipe *34* which is in communication with a pipe *35* through which all the dirt and separated matter removed from the juice discharges. Each of the screens is provided with a lower deflecting member *33* to guide the juice toward the straining wall of the same. Carried by the casing above the upper edge of the lower screen or strainer is a deflector pan *43* to insure that all juice entering the straining structure actually passes through the screens. To prevent any strained juice passing into the discharge pipe *34*, the member 14^{b} is provided with a deflector *45*, so as to be discharged from the casing.

In order that the screens may be cleaned of any collected matter should such action ever become necessary, steam jets are provided for the purpose. To this end, pipes *46* may be introduced at one side of the apparatus and be disposed directly adjacent the screens, at the same angle and parallel therewith. The cleaning of the screens may go on while the juice is being strained, or after The several screens are stayed with respect to the shaft *5* by means of suitable rods *50*, pivotally connected at *51* to the hubs *41* of the deflectors *43*, and at *52* to brackets *53*, secured to the ribs *13* of the respective screens, whereby all danger of the screens running out of true is avoided. These stay rods are preferably provided with turnbuckles *54* to permit adjustment with respect to the screen walls and shaft, and insure proper alignment, thus insuring proper operation of the screens.[1]

UNITED KINGDOM COMPLETE SPECIFICATIONS ACCEPTED.

CONFECTIONERY MOULDING MACHINES. ***National Equipment Co.*** *152,720* (*15,575*). June 20th, 1919.

TREATMENT OF PEAT. ***Molassine Co., and H. C. S. de Whalley.*** *152,779* (*18,234*). July 22nd, 1919.

STRAINING DEVICE. ***H. W. Manery.*** *152,911* (*3379*). February 4th, 1920.

ULTRAMARINE BLUE MANUFACTURE. ***J. B. Guimet and A. Guillochin.*** *152,916* (*4576*). February 14th, 1920.

CENTRIFUGAL MACHINE. ***P. T. Sharples.*** *153,041* (*15,792*). June 23rd, 1919.

PREVENTING INCRUSTATION IN EVAPORATORS. ***Aktieselskapet de Norske Saltverker,*** *131,279* (*17,451*). August 14th, 1918.

COATING MACHINES FOR CONFECTIONERY. ***National Equipment Co.*** *153,541* (*21,671*). June 5th, 1919. (Divided application on 150,779).

MANUFACTURE OF GRAPE HONEYS AND FRUIT SYRUPS. ***Barbet et Fils et Cie.*** *153,548* (*1972*). October 31st, 1919.

BEET HARVESTERS. ***H. C. Hansen and A. C. Andersen.*** *153.657* (*19.512*). August 7th, 1919.

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[1] This apparatus is made by the Horton-Brown Corporation, of 149, Broadway, New York, U.S.A. (see advertisement), and the British agents are the Sugar Manufacturers' Supply Co., Ltd., of 2. St. Dunstan's Hill, London, E.C. 3.

Sugar Crops of the World.

(Willett & Gray's Estimates of Crops tc November 11th, 1920.)

	Harvesting Period.	1920-21. Tons.	1919-20. Tons.	1918-19. Tons.
United States—Louisiana	Oct.-Jan.	175,000	108,035	250,802
Porto Rico	Jan.-June	435,000	433,825	362,618
Hawaiian Islands	Nov.-July	525,000	505,500	538,913
West Indies—Virgin Islands	Jan.-June	5,000	12,400	9,000
Cuba	Dec.-June	4,000,000	3,730,077	3,971,776
British West Indies—Trinidad	Jan -June	60,000	58,416	47,860
Barbados	,, ,,	50,000	50,000	75,271
Jamaica	,, ,,	45,000	46,875	43,000
Antigua	Feb.-July	13,500	15,540	12,841
St. Kitts	Feb.-Aug.	8,000	10,036	10,901
Other British West Indies	Jan.-June	10,000	5,651	7,580
French West Indies—Martinique	Jan.-July	20,000	22,000	10,027
Guadeloupe	,, ,,	25,000	31,000	26,604
San Domingo	Jan.-June	189,000	175,736	158,309
Haiti	Dec.-June	5,000	5,000	3,300
Mexico	,, ,,	100,000	92,000	70,000
Central America—Guatemala	Jan.-June	15,000	15,000	13,441
Other Central America	,, ,,	20,000	20,000	14,240
South America—				
Demerara	Oct.-Dec. and May-June	100,000	96,000	107,560
Surinam	Oct. Jan.	12,000	12,000	8,000
Venezuela, *exports*	Oct.-Dec.	20,000	18,000	16,970
Ecuador	Oct.-Feb.	8,000	7,000	7,000
Peru	,, ,,	350,000	350,000	300,000
Argentina	May-Nov.	225,000	292,110	130,266
Brazil	Oct.-Feb.	300,000	177,155	183,079
Total in America		6,715,500	6,289,356	6,379,348
Asia—Brit. India (consumed locally)	Dec.-May	3,000,000	3,049,157	2,370,000
Java	May-Nov.	1,515,000	1,335,763	1,749,408
Formosa and Japan	Nov.-June	350,000	283,482	415,678
Philippine Islands, *exports*	,, ,,	200,000	203,000	195,289
Total in Asia		5,065,000	4,871,402	4,730,375
Australia	June-Nov.	175,000	175,000	209,853
Fiji Islands	,, ,,	60.000	60,000	80,000
Total in Australia and Polynesia		235,000	235,000	289,853
Africa—Egypt (consumed locally)	Jan.-June	80,000	90,000	75,899
Mauritius	Aug.-Jan	240,000	235,490	252,770
Réunion	,, ,,	40,000	40,000	50,000
Natal	May-Oct.	160,000	150,000	185,000
Mozambique	,, ,,	40,000	35,000	20,615
Total in Africa		560,000	550,490	584,284
Europe—Spain	Dec.-June	5,000	6,048	6,618
Total cane sugar crops		12,580,500	11,952,296	11,990,478
Europe—Beet sugar crops		3,520,000	2,689,071	3,250,309
United States—Beet sugar crop	July-Jan.	950,000	652,957	674,892
Canada—Beet sugar crop	Oct.-Dec.	35,000	16,506	22,300
Total beet sugar crops		4,505,000	3,358,528	3,947,501
Grand total Cane and Beet Sugar	**Tons**	**17,085,500**	**15,310,824**	**15,937,979**
Estimated increase in the world's production	**,,**	**1,774,676**	....	....

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

	One Month ending November 30th.		Eleven Months ending November 30th.	
	1919. Tons	1920. Tons.	1919. Tons.	1920. Tons.
Unrefined Sugars.				
Russia	....	....	....	...
Germany	....	2	....	5,966
Netherlands	....	....	1	....
Belgium	654	....	654	..
France	....	...	....	....
Austria-Hungary	....	....	..	....
Java	5,324	90,015	165,522	253,302
Philippine Islands	2,931	1	4,669	1
Cuba	61,379	1	546,137	506,601
Dutch Guiana	102	....	1,354	59
Hayti and San Domingo	....	...	....	14
Mexico	....	....	....	....
Peru	14,495	2,374	71,229	37,454
Brazil	....	1,585	6,227	7,748
Mauritius	7,544	19,643	128,896	126,119
British India	951	6	4,335	16,752
Straits Settlements	....	....	....	....
British West Indies, British Guiana & British Honduras	3,150	1,090	109,056	122,710
Other Countries	663	3,173	15,186	40,592
Total Raw Sugars	**97,192**	**117,890**	**1,053,265**	**1,117,316**
Refined Sugars.				
Russia	708	....	708	1
Germany	.. ..	....	....	126
Netherlands	2,166	1	13,083	1,067
Belgium	1,282	2	3,917	2,116
France	....	....	23	24
Austria and Hungary	380	....	380	123
Java	10,000	1	110,930	5,013
United States of America	23,711	15	183,960	100,434
Argentine Republic	....	4	10	49
Mauritius	....	....	16,602	....
Other Countries	9,691	78	60,608	7,835
Total Refined Sugars	**47,938**	**102**	**390,220**	**116,787**
Molasses	11,929	1,451	112,442	67,553
Total Imports	**157,059**	**119,443**	**1,555,927**	**1,301,656**

EXPORTS.

	Tons.	Tons.	Tons.	Tons.
British Refined Sugars.				
Denmark	....	....	....	....
Netherlands	1	451	1	561
Portugal, Azores, and Madeira	....	43	....	47
Italy	....	....	....	....
Canada	....	....	1	....
Other Countries	136	380	1,189	1,400
	137	874	1,192	2,008
Foreign & Colonial Sugars.				
Refined and Candy	1,178	3,592	3,753	6,442
Unrefined	1,374	263	33,609	9,868
Various Mixed in Bond	....	....	....	....
Molasses	416	514	8,189	3,731
Total Exports	**3,105**	**5,243**	**46,743**	**22,049**

Weights calculated to the nearest ton.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1920 Tons.	1919. Tons.
Total Receipts January 1st to November 24th	2,784,411	2,740,565
Deliveries ,, ,,	2,775,826	2,740,565
Meltings by Refiners ,, ,,	2,361,421	2,718,000
Exports of Refined ,, ,,	325,000	435,000
Importers' Stocks, November 23rd	8,585	—
Total Stocks, November 23rd	72,843	34,055
	1919.	1918.
Total Consumption for twelve months	4,067,671	3,495 606

Beet Crops of Europe.

(Willett & Gray's Estimates to November 11th, 1920.)

	Harvesting Period.	1920-21. Tons.	1919-20. Tons.	1918-19. Tons.
Germany	Sept.-Jan.	1,150,000	750,000	1,324,579
Czecho-Slovakia	Sept.-Jan.	650,000	535,000	700,000
Hungary and Austria	Sept.-Jan.	50,000	50,000	
France	Sept.-Jan.	250,000	151,444	110,096
Belgium	Sept.-Jan.	225,000	146,918	74,183
Holland	Sept.-Jan.	300,000	238,692	173,436
Russia (Ukraine, Poland, etc.)	Sept.-Jan.	175,000	225,000	336,616
Sweden	Sept.-Jan.	175,000	145,000	127,467
Denmark	Sept.-Jan.	165,000	160,000	144,600
Italy	Sept.-Jan.	175,000	182,843	106,682
Spain	Sept.-Jan.	175,000	81,650	139,409
Switzerland	Sept.-Jan.	10,000	8,550	10,800
Bulgaria	Sept.-Jan.	10,000	10,974	2,441
Roumania	Sept.-Jan.	10,000	....	....
		3,520,000	2,689,071	3,250,309

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR ELEVEN MONTHS ENDING NOVEMBER 30TH, 1913, 1919, 1920.

	IMPORTS.			EXPORTS (Foreign).		
	1913. Tons	1919. Tons.	1920 Tons.	1913. Tons	1919. Tons.	1920 Tons.
Refined	811,196	390,220	116,787	736	3,753	6,442
Raw	939,658	1,053,265	1,117,316	3,870	33,609	9,868
Molasses	143,910	112,442	67,553	340	8,189	3,731
	1,894,764	1,555,927	1,301,656	4,946	45,551	20,041

	HOME CONSUMPTION.		
	1913. Tons.	1919. Tons.	1920. Tons.
Refined	799,203	352,517	138,493
Refined (in Bond) in the United Kingdom	665,527	763,708	727,953
Raw	107,304	265,945	173,871
Molasses	29,220	42,148	26,342
Molasses, manufactured (in Bond) in United Kingdom	34,480	65,505	64,727
Total	1,635,734	1,489,823	1,131,386
***Less* Exports of British Refined**	21,713	1,192	2,008
	1,614,020	1,488,631	1,129,378

Sugar Market Report.

Our last report was dated 6th November, 1920.

In accordance with the notice issued by the Royal Commission on the 29th November, the prices fixed for Granulated, Crushed and White Pieces now stand at 80s. per cwt., duty-paid wholesale and 10d. por lb. retail; these limits also apply, as maxima, to "free" sugars and W.I. Crystallized, Muscovados, etc., and are in force until further notice, instead of for the usual four-weekly period. The rationing of supplies was discontinued from the same date. The call for decontrol has been popularized by the Press, and there are people who hold the opinion that it will take place early in the new year. Although it is not safe to predict when political exigency enters into a question, there are others who look for a longer period of control, in view of the fact that the Royal Commission is believed to have acquired enough sugar to last until May or June next, which holding could not be regarded as a factor likely either to encourage, or minimize the risk of, private importations. It is generally expected, however, that an early concession may be made to manufacturers regarding the unrestricted import of white sugar.

The remnants of "free" white sugar on the spot are small and are being taken by users in hand-to-mouth fashion at about controlled prices; Mauritius Crystals 79s., American Granulated 80s per cwt. duty-paid. There is a moderate demand for W.I. Crystallized at about 68s. to 72s. per cwt., whilst fine Barbados Syrups are offered at about 50s., and lower kinds down to 30s. per cwt. duty-paid, without meeting anything but a poor enquiry.

The Royal Commission has been a buyer of Peruvian 96's, which have shown a steady decline from 36s. down to 27s. 9d. per cwt. f.o.b. They are said to have made other purchases, including Brazils, Demeraras and some quantity of Polish beet.

During the past month the trend of prices has continued steadily downward, since there has been nothing in outside conditions to ameliorate the critical state of affairs ruling in Cuba. On the contrary, the fall has only served to reveal financial weakness in fresh quarters, an instance of which is the inability of certain Canadian refiners to take up their contracts Owing to the failure of the negotiations for a loan by the American banks, the announcement on 1st December that the moratorium in Cuba, expiring on that date, would be extended until the end of the year, did not occasion surprise; nor could the pressure of sales from Cuba be expected to result in anything but further depreciation. Hence, the quotation for Centrifugals stands to-day at 4·25 cents f.o.b. (equal to about 27s. 6d. per cwt.) although it is reported from America that the Cuban Committee had refused to sell a round quantity to the Royal Commission at 5·30 cents. American Granulated is quoted at 7·00 cents per lb. f.o.b. (say 45s. per cwt.).

American imports from extraneous sources have exceeded expectations, and with the reduced meltings consequent on the closing of many refineries, it now looks as though the total stocks at the end of the year (including the stock in Cuba) will be in the neighbourhood of 1,000,000 tons, against about 300,000 tons in the previous year. With such an ample stock and the prospect of increasing supplies shown by the latest estimates, the U.S. may be assured of sufficient sugar to cover any increase in distribution next year.

The following table shows the estimates for the principal countries concerned, compared with the previous year :—

	Latest estimates	Previous year
U.S. Domestic Beet	950,000	650,000
Louisiana	175.000	108,000
Cuba	4,000,000	3,730,000
Porto Rico	430,000	433,000
Hawaii	525,000	506,000

but it is impossible to say to what extent the final outturn of the crops may be influenced by financial and labour conditions.

The price of Java whites shows a further decline of about 5 guilders, to 25 guilders per picul f.o b. (about 37s. 6d. per cwt.), after a temporary improvement on some demand for shipment to India. At one moment as high as 52s. per cwt. f.o.b. Calcutta was quoted, as against to-day's price of 39s. 6d., at which there are no buyers. For Mediterranean destinations there are many enquiries which, however, lack the support of the necessary credits for the business. The nominal value may be put at about 45s. per cwt. c.i.f.

There is nothing to indicate an improvement in the financial situation in the near future, and although on the first signs of financial stability it may be seen that values have been forced too low, the general outlook is such as to discourage the belief in any sustained advance.

H. H. Hancock & Co.

10 & 11, Mincing Lane,
London, E.C. 3,
6th December, 1920.

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